ADDRESSING THE PROJECT IMPLEMENTATION CHALLENGES IN THE SAUDI ARABIAN POWER SUPPLY INDUSTRY: AN INVESTIGATIVE APPROACH TOWARDS IMPROVING PROJECT DELIVERY

BANDAR ALHOWEISH

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ASTON UNIVERSITY

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Thesis Summary

For many decades, the Kingdom of Saudi Arabia has been widely known for being a reliable oil exporter. This fact, however, has not exempted it from facing significant domestic energy challenges. One of the most pressing of these challenges involves bridging the widening electricity supply-demand gap where, currently, the demand is growing at a very fast rate. One crucial means to address this challenge is through delivering power supply projects with maximum efficiency. Project delivery delay, however, is not uncommon in this highly capital-intensive industry, indicating electricity supplies are not coping with the demand increases. To provide a deeper insight into the challenges of project implementation and efficient practice, this research adopts a pragmatic approach by triangulating literature, questionnaires and semi-structured interviews. The research was conducted in the Saudi Arabian power supply industry – Western Operating Area. A total of 105 usable questionnaires were collected, and 28 recorded, semi-structured interviews were conducted, analysed and synthesised to produce a conceptual model of what constitutes the project implementation challenges in the investigated industry. This was achieved by conducting a comprehensive ranking analysis applied to all 58 identified and surveyed factors which, according to project practitioners in the investigated industry, contribute to project delay. 28 of these project delay factors were selected as the 'most important' ones. Factor Analysis was employed to structure these 28 most important project delay factors into the following meaningful set of 7 project implementation challenges: Saudi Electricity Company's contractual commitments, Saudi Electricity Company's communication and coordination effectiveness, contractors' project planning and project control effectiveness, consultant-related aspects, manpower challenges and material uncertainties, Saudi Electricity Company's tendering system, and lack of project requirements clarity. The study has implications for industry policy in that it provides a coherent assessment of the key project stakeholders' central problems. From this analysis, pragmatic recommendations are proposed that, if enacted, will minimise the significance of the identified problems on future project outcomes, thus helping to ensure the electricity supply-demand gap is diminished.

Key words: project management, project delay, Saudi Arabia, electricity supply projects

Dedication

I dedicate this work to my parents.

I dedicate this work to my beloved wife.

Acknowledgements

I would like to acknowledge my limitless gratefulness to Allah Almighty for granting me countless blessings. Without His blessings, I would not have been able to complete this thesis. Infinite praises are due to Allah and may endless peace and blessings be upon His beloved Messenger Mohammed.

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1. Research Introduction

1.1 General Introduction

In the middle of 2008, the global economy suffered its worst contraction since World War II as a direct result of the financial crisis. The resulting recession had (and is still having) a dramatic impact on various challenges facing the world. At the heart of these challenges is the security of energy supply, something that has continuously fuelled the concerns of both politicians and economists. Lessons are still being learned about the unfortunate economic downturn that hit every region of the world. As a consequence, various governments have adopted new measures and policies in response to the crisis in order to seek the rapid recovery of their economies.

The International Energy Agency (IEA) has the privilege of having the most authoritative sources of information and analysis in the international energy sector, assisting policy makers around the world to pursue adequate regulations and policies that serve their interests. In its 2009 *World Energy Outlook* report, it optimistically, but carefully, stated that there were signs that the world economy was beginning to recover from the recession, although the global GDP fell by 6.5% in the fourth quarter of 2008 (on an annualised basis), with emerging economies contracting by 4% and the advanced economies by around 8%. However, according to the same report, the exact shape of the recovery remains uncertain and fluctuating.

This optimistic economic recovery forecast was, though, coupled with a genuine concern that future energy demand will be more challenging than ever. Since the onset of the recession, the lower cash flow driven by the tougher financing environment has weakened final demand for energy and, therefore, many ongoing energy projects (drilling oil and gas wells, building refineries, pipelines and power stations, etc.) have been slowed, postponed or even cancelled. As a result, the energy investment shortfall could potentially have serious consequences for energy security when demand is likely to be recovering. For example, the report estimated that global upstream oil and gas investment budgets for 2009 would be cut by 19% compared with 2008 (IEA, 2008, IEA, 2009). Power sector investment was also severely affected by financial difficulties and by weak demand for the short term. However, the likely global economic recovery in the future will increase energy demand, and the estimated capital required to meet the projected demand through to 2030 amounts to $25.6 trillion (in 2008 dollars). This is equivalent to 1.4% of global GDP per year on average (or $1.1 trillion). Over half of the total investment (53%) is required for the power sector alone. This will be needed to expand supply capacity and to replace existing aging facilities that will be closed during the projection period. If the investment in the oil, gas and coal supply chains required to meet global power generation fuel needs was taken into account, power sector investment needs will rise to about 70% of total energy investment (IEA, 2009).

Compared to the 2008 outlook (IEA, 2008), world electricity demand in 2030 is projected to be slightly higher in contrast to all other final forms of energy (IEA, 2009). World electricity demand was projected to grow at an annual rate of 2.5% over the period 2007-2030 (Table 1.1). Non-OECD accounted for over 80% of the growth, with a 3.9% rate of annual growth for the quoted period (IEA, 2009).

Table 1.1: Final electricity consumption by region in Reference Scenario (TWh)

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Source: (IEA,2009)

Table 1.2 shows that installed power generation capacity for the world is projected to rise from 4509 GW in 2007 to 7820 GW in 2030, with 30% of the increase installed by 2015. Over half of the total investment required for the power sector is needed for generating plants ($7.2 trillion), and the remainder is required for both transmission ($2 trillion) and distribution networks ($4.5 trillion).

Table 1.2: Projected capacity additions and investment in power infrastructure by region

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Source: (IEA,2009)

1.2 The Saudi Arabian Role in the Global Oil Market

Since September 1960 when, with four other countries (Iraq, Iran, Kuwait and Venezuela), it formed the Organisation of Petroleum Exporting Countries' (OPEC) in Baghdad, the Middle Eastern Kingdom of Saudi Arabia has played a key role in the international energy market (OPEC, 2010). According to its official Ministry of Petroleum and Mineral Resources website (MOPM, 2010), the Kingdom owns the world's largest oil reserves, proven and recoverable, of around 260 billion barrels (one quarter of the world reserves), 13% of world production and a refining capacity of more than 3.5 million barrels per day. Therefore, its current role as the leading petroleum country in terms of reserves, production, exports and refining capacity can never be under-estimated. Its future role is even more crucial for securing world energy supplies if it is considered that the Kingdom's production rate of 13% of world production is not in proportion to the capacity of its reserves (25% of the world's total). Although its 2009 production rate was approximately 9.6 million barrels per day (BP, 2010), the Kingdom increased its production capacity to 12 million barrels per day in 2010. If world consumption proves demanding, the Kingdom is considering the possibility of raising the production capacity to 15 million barrels per day to stabilise the fluctuating market (MOPM, 2010).

The *World Energy Outlook* has estimated that the OPEC share of the global oil market will increase from 44% today to 55% in 2030 (IEA, 2009). The IEA Chief Economist has expressed genuine concern that failure to invest in new oil and gas infrastructure may result in supply shortfall that will lead to new record energy prices. Although today's 12-member organisation OPEC is keen to efficiently play its role in securing world energy supplies of oil, challenges vary from one country to another. This is especially true when considering the catastrophic oil rig explosion in the Gulf of Mexico on April 20th, 2010. BP's Deepwater Horizon rig explosion was the world's largest accidental offshore oil spill, killing 11 workers and injuring 17. According to a US government estimate, the ruptured Macondo well spilled 4.9 million barrels in 152 days before it was finally sealed (Meyer, 2010, Pfeifer, 2010). According to Barclays Capital commodities research team member Amirta Sen,

> The spill is an obvious severe blow to the reputation of the industry, and raises a whole series of questions about the technology that is key to the development of the deep and ultra-deep water fields that represent the frontier for non-OPEC production.
>
> (Sen, 2010)

Before the accident, Deutsche Bank estimated that deep water production would account for 10% of global oil production for the period 2008 – 2015. However, both Norway and China have stopped any deep water drilling and will not allow any further drilling, at least for the short term (Hume, 2010). The UK Department of Energy, on the other hand, has agreed to let Chevron begin drilling off the Shetland coast since, compared to the USA, the Department has placed greater stress on having much stricter safety regulations in the UK (Stacey, 2010). In fact, the Obama administration has already lifted the ban on deep water oil drilling in the US after imposing new rules that are believed to reduce the risk of similar catastrophic accidents (Daly, 2010). However, the overall resultant shortage in oil supplies will shift the pressure of balancing the global oil demand-supply towards OPEC – especially Saudi Arabia as the top producer and exporter in the Cartel - which is very keen on stabilising oil prices within the $70-$80 per barrel levels (Blair, 2010).

1.3 Research Problem Statement

To efficiently play its international role as main energy resource provider, Saudi Arabia needs to effectively address its internal and national challenges. Thanks to the spiked oil prices that accounted for over 90% of its export earnings, the Saudi Treasury has enjoyed enormous income from its oil reserves with the Ministry of Finance announcing consistently high governmental expenditure for seven consecutive years between 2004 and 2010 (Table 1.3) (OPEC, 2010, MOF, 2010). Yet, the Kingdom is facing serious questions over the quality of various public services. Astonishingly, meeting the national electricity demand is now at the top of the government's agenda.

The frequent service interruptions, especially in the summer when the demand peaks, have "left many Saudis wondering bitterly why the world's top energy exporter could not supply more electricity to its own people" (Allam, 2010). While world electricity demand is projected to annually increase by 2.5% in the period 2007 – 2030 (IEA, 2009), Saudi Arabia's demand is growing at the much faster rate of 8% (KFUPM, 2006, SEC, 2009).

Table 1.3: The Saudi Government Budget Data

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Source: Ministry of Finance

In June 2010, the government formed a Committee of six Ministers to immediately report recommendations on methods for financing the required expansive investments on time. In the short term, Saudi Arabia requires an allocation of SR 330 billion (US$ 88 billion) to invest in new projects between 2009-2018 (SEC, 2009). This shows that most of the investment required in the Middle East for additional power infrastructure ($127 billion over 2008-2015) will take place in Saudi Arabia (IEA, 2009). Moreover, it has been estimated that the additional required generating capacity in Saudi Arabia will triple from 45 GW in 2008 to 120 GW in 2032 just to meet the growing national demand for electricity.

These facts represent compounded challenges for Saudi Arabian policy makers. According to the Electricity Co-generation Regulatory Authority (ECRA) governor in June 2010, the heavily subsidised service was consuming 320 million barrels of oil equivalent in 2009 and was projected to consume 900 million barrels of oil equivalent in 2032. The adopted mono-generation policy of burning fossil fuels placed Saudi Arabia as the sixth largest oil consumer with a daily consumption rate of 2.6 million barrels per day in 2009. This consumption rate exceeded that of Germany, the largest European economy, which consumed 2.4 million barrels per day in 2009 (BP, 2010). Moreover, when oil is likely to have a decreasing role in world power generation (from 6% of total oil consumption in 2007 to 2% in 2030) (IEA, 2009), Saudi Arabia is likely to triple its oil consumption to generate electricity over roughly the same period.

This research adopted a problem-driven approach where the researcher explicitly asked the following question to the Deputy Minister of Electrical Affairs, the Board Chairman of the Saudi Electricity Company, Dr. Saleh Al-Awaji: “Among all the challenges surrounding the Saudi electricity industry, what is your top concern?” The answer was immediately given: “Delivering Power Projects on time!” Knowing that Saudi Arabian public projects are severely impeded by many different factors, the concern was not a surprise. The Saudi media (newspapers) have pointed to many possible reasons and explanations but, unfortunately, with no sufficient intervention or

Table 1.2: Projected capacity additions and investment in power infrastructure by region

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Source: (IEA,2009)

1.2 The Saudi Arabian Role in the Global Oil Market

Since September 1960 when, with four other countries (Iraq, Iran, Kuwait and Venezuela), it formed the Organisation of Petroleum Exporting Countries' (OPEC) in Baghdad, the Middle Eastern Kingdom of Saudi Arabia has played a key role in the international energy market (OPEC, 2010). According to its official Ministry of Petroleum and Mineral Resources website (MOPM, 2010), the Kingdom owns the world's largest oil reserves, proven and recoverable, of around 260 billion barrels (one quarter of the world reserves), 13% of world production and a refining capacity of more than 3.5 million barrels per day. Therefore, its current role as the leading petroleum country in terms of reserves, production, exports and refining capacity can never be means for addressing the dilemma of meeting the growing demand for electricity in the Kingdom, the research also aimed to explore the various challenges, and their significance, surrounding the Saudi Arabian power supply industry in order to appreciate the role of projects in minimising their effects. The main objectives of the research study were as follows:

- To develop a basic understanding of the challenges facing the Saudi Arabian electricity industry. This required conducting a comprehensive review of the industry history to understand how these challenges developed.
- To document the industry-related adopted polices and assess their role in addressing the identified industrial challenges.
- To conduct a comprehensive analysis of the project management practice in the investigated industry and present the significant factors contributing to project delay identified by the frontline project practitioners.
- To construct a conceptual model of the Project Implementation Challenges (PICs) in the project electricity supply industry. These were formulated by the identified project delay factors.

1.5 Research Significance and Areas of Knowledge Contribution

The research findings have been used to inform the Saudi electricity-related organisations of the most pressing "Project Implementation Challenges" and their potential impact on project delivery progress. These have provided the Saudi Electricity Company and their relevant Contractor and Consultant executives a coherent outlook of their projects' central problems. The research significance would be, therefore, motivating all relevant stakeholders, especially the Saudi Arabian government and the Saudi Electricity Company, to embrace practical recommendations and rational actions in order for them to improve the state of the Saudi Arabian electricity industry.

This study has contributed two main areas of knowledge to the research field. The first contribution was the provision of a comprehensive descriptive analysis of the serious challenges facing the Saudi Arabian power supply industry and their potential impact on the international and domestic oil and gas industries. This study has critically reviewed the development of these pressing challenges with a comprehensive explanation of the constraints facing the policy makers. The other area of knowledge contribution was the development of a coherent and detailed model describing the challenges impeding the timely delivery and operation of the power supply projects in Saudi Arabia. These challenges were thoroughly appraised and critically reviewed for the first time.

1.6 Research Scope and Limitations

The study focused on authorised turnkey projects, a type of project in which relevant funds are already allocated; therefore, it is imperative that these projects are executed in a timely manner to meet the country's need for electricity supplies. Hence, the research has confined the investigation to one which seeks to comprehend the working relationship between the key project stakeholders of project owner, project contractors and project consultants in all three project areas of power generation, power transmission and power distribution projects. The project owner in this research was represented by the Saudi Electricity Company (SEC), which had the major share of electricity generation, accounting for 81% of the Kingdom's total generation. Geographically, this research took place in the Western Operating Area, which accounted for 30.9% of total electricity consumption in the Kingdom, the highest when compared to other operating areas.

Below are listed the limitations of this research study:

- Although the research focused on the key project stakeholders involved in the Saudi electricity supply industry (i.e. the Saudi Electricity Company (SEC), Contractors and Consultants), very few interviews were conducted with Contractor Project Managers (PMs) (only two recorded interviews) and only one (non-recorded) conversation with a Consultant PM. Accessing these industry key players' was indeed very difficult. Contractor and Consultant PMs felt uncomfortable criticising the SEC's behaviour as a client. This, understandably, was reasoned by the desire to prevent any chance of sharing information with the SEC in a manner that may affect the relationship between the two. Consultants, however, revealed even greater resistance to both conducting interviews and filling in the questionnaire. Similarly, this was also reasoned as a desire to prevent any chance of sharing information with the SEC which might damage their relationship with the SEC. This is especially true when the small sample of Consultant PMs who participated in the questionnaire survey regarded the SEC-related Project Delay Factors (PDFs) group as their most important one. For these reasons, the research mainly focused on the SEC's participants' point of view.

- Fifty eight PDFs were considered in the questionnaire survey. The researcher probably missed an important PDF, although an extensive review of the literature and careful listening to the recorded interviews were carried out. Yet, the researcher identified a PDF during the questionnaire pilot study through a participant, and might have missed more. Moreover, each PDF could be viewed from different angles. This presented a challenge in interpreting these PDFs differently. All of these were causes of project delay. These can also be viewed as effects rather than causes, or even both. The progressive nature of the research developed the descriptions and interrelations of these PDFs.

- The study was based on a convenience research participant sample and, therefore, generalisation was avoided. However, some degree of agreement between PMs who worked for different organisations with varying project interests and experiences presented some confidence in the findings. These findings were believed to be reflective of the project environment reality.

- The ranking results of the surveyed PDFs are likely to change with time. Therefore, the elements of the Project Implementation Challenges Model will consequently change, presenting a new set of topical problems. This change will either result from enforcing remedial actions to resolve these challenges or new problems will create even more complex challenges. Most likely, the change will result from the mixture of these two possibilities. However, the main purpose of this study was to suggest a practical, remedial set of actions to minimise the effect of the modelled PICs. In other words, the study advocated improving the project management practice in the industry that would lead to the introduction of a new set of Project Implementation Challenges.

- The study was not able to analyse project differences between Power Generation, Power Transmission and Power Distribution projects in great depth. This required data collection relevant to numerical information of project values and the extent of delays in these projects before conducting any comparison analysis. These data were not accessible.

- The study did not report information about the extent of project delay in the industry. In addition to the restrictive access to such data, the literature also proved that such information was not usually accessible.

2. The Saudi Arabian Electricity Industry Challenges

2.1 Introduction

Since the research problem plays a key role in bridging the seemingly growing electricity supply-demand gap in Saudi Arabia, it was convenient to first understand the challenges facing the industry as a whole before narrowing the focus towards uncovering the Project Implementation Challenges in the same industry. Therefore, this chapter will present the most pressing challenges that concern the policy makers, followed by a more focused research question statement with explicit explanation of its relevance and significance to address the industry's challenges. It is argued that the challenges described in this chapter have been developing since the early days of the industry. Therefore, Appendix A presents the historical development of the Saudi Arabian electricity industry with thorough description of the current physical infrastructure (i.e. Power Generation capacities, Transmission Grids and Power Distribution Networks) along with identifying the key industry stakeholders and their roles. Before stating the holistic challenges facing the investigated industry, it was convenient to present the relevant issues contributing to the industry challenges into two categories: demand-side issues and supply-side issues. These issues will be followed with a brief profile description of the Saudi Electricity Company as the Project Owner and its key project departments.

2.2 Demand-side Issues

This section describes relevant matters that influence the increasing demand for electricity in Saudi Arabia. When electricity was first introduced in Saudi Arabia, the consumption was modest and it was mainly used for lighting. Consumers were then slowly introduced to new electrical appliances, and this was when loads started increasing. Before the government took over the ownership of the supply industry, electricity businesses produced very generous profits for its private producers, and the tariffs varied from one producer to another depending on the cost of production and operation. The government's first intervention was in 1954 when it set, for example, the electricity price in Jeddah (the largest city after Riyadh, the Capital) from SR 0.55/kWh to SR 0.325/kWh (SR: Saudi Riyals; US$ 1 = SR 3.75). The level of tariff adjustment was believed to offer a very reasonable return to the service producers. In 1959, the Council of Ministers decided to introduce a new tariff scheme, as shown in Table 2.1, where more reduction was applied.

Table 2.1: Electricity tariffs in a few major cities in 1959

In the 1970s, however, Saudi consumers became familiar with more electrical appliances, including air conditioning, as a result of increased per capita income, and this immediately reflected in an electricity demand increase. This was in addition to the development plans that encouraged construction, industrial and agricultural growth. The increased oil revenues in the 1970s shifted the Saudi lifestyle dramatically, both socially and economically, and electricity was transformed from a privilege to have into a social right. This was when the government was financially very stable and thus able to promote further reductions in the tariff and guarantee the private producers subsidies that covered their operating costs with a promise of providing a profit margin of 15%. Table 2.2 shows how low the tariff was when it was introduced in 1972 when further reductions were applied.

Table 2.2: Electricity prices in various cities as per Royal Decree (1099) of January 17, 1972

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The tariff was subject to more modifications in which additional subsidies were offered, adding financial burdens to the government's budget. In the late 1980s and early 1990s, oil revenues dropped and this affected the government's budget. Moreover, the second Gulf War was an unexpected additional and very intensive cost. To act upon necessary budget spending cuts, the Council of Ministers requested the Ministry of Industry and Electricity (at the time) to conduct a comprehensive study to reform the costly industry. In 1995, the Ministry of Industry and Electricity suggested the necessity of restructuring the entire industry and the need to merge all regional electricity companies (SCECOs) into a single entity as a first step to introduce a liberal and free electricity market. The Council of Ministers approved the recommendation in 1998 and the Saudi Electricity Company (SEC) became operational in April, 2000. Table 2.3 shows the tariff structure that offered a reasonable financial income where the company could manage its operational and maintenance costs, re-pay credit facilities and loans inherited from the previous companies, and finance required expansive capital investments along with the support of government subsidies.

Table 2.3: The SEC tariff as of April 6, 2000

Monthly Consumption (kWh)	Residential, Commercial, Government (SR/kWh)	Agricultural, Cahirtable, Socienties (SR/kWh)	Industrial (SR/kWh)
1 - 2,000	0.05	0.10	0.12
2,001 - 4,000	0.10		
4,001 - 5,000	0.13	0.12	
5,001 - 6,000	0.18		
6,001 - 7,000	0.23		
7,001 - 8,000	0.28		
8,001 - 9,000	0.32		
9,001 - 10,000	0.36		
> 10,000	0.38		

Source: (ECRA, 2008)

The tariff was then changed in less than seven months as shown in Table 2.4. A review of the official documents that described the history of tariff changes in Saudi Arabia (ECRA, 2007, ECRA, 2008, MIE, 2000, MIE, 2004, SEC, 2009) reveals an apparent lack of explanation for understanding the forces surrounded these changes. The government was sensitive to point out the implications of such tariff reductions. To discover why these reductions were forced through in such a short time, Dr. Saleh Al-Awaji, Deputy Minister of Electrical Affairs and Chairman of the Board of the Saudi Electricity Company, was asked to explain. Dr Saleh Al-Awaji stated that “those who were capable to pay, unfortunately, were the ones who complained and influenced the decision makers to reduce the tariff.” The Deputy Minister explicitly pointed out that these influencers complained to the King, Crown Prince or the Second Deputy of Council of Ministers to reinstate the older tariff.

Table 2.4: The SEC tariff as of October 28, 2000

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Comparing the last two tariff schemes, the amended tariff affected only residential users who consumed over 4000 kWh per month, in addition to agricultural users. This provided evidence for Dr. Al-Awaji's statement that capable consumers influenced the reduction of the, seemingly, commercial tariff introduced just seven months before.

The sector officials strongly believed that subsidies and controlling service prices were necessary for social wellness and economic development. Introducing low tariffs attracted local and foreign investors to base their industries in Saudi Arabia, thus boosting non-oil businesses. However, the extent of these tariff subsidies was not reflecting the operational cost of the SEC and did not encourage efficient electricity usage.

In the presence of a World Bank representative, the Minister announced in a press conference to the public media that Saudi Arabia was flooded with non-compliant and inefficient electrical appliances with a striking share of 80% of the local market (Qahtani, 2008). Since its establishment, the Saudi Arabian Standards Organisation (SASO) has suggested specific electrical appliance standards but has not had the authority to enforce these standards (Al-Ajlan et al., 2006, Qahtani, 2008). Moreover, the low tariff encouraged wasteful usage of electricity, whether from residential, industrial or commercial users. The Ministry of Water and Electricity undertook several campaigns for electricity rationalisation, but they were largely ineffective as no incentives were offered, especially with such a low tariff. These campaigns were described as follows:

> They serve as a valuable lesson to show that unless sustainable energy conservation policies are developed at a national level, they are themselves unsustainable. More importantly, such policies will not take root unless mandated by law, which in the Saudi context means a decree issued by the Council of Ministers.
>
> (Al-Ajlan *et al*., 2006).

Today, Saudi Arabia is experiencing huge development, with new industrial cities being built from scratch (SAGIA, 2010). These developments have already led international investors to base their business operations and manufacturing facilities in these new cities. There were also aggressive plans to electrify all rural areas that remain without the service by 2011 (SEC, 2003). These areas were either completely deprived of electricity access or paying private producers commercial prices. Such developments, when coupled with its rapid population growth - - 2.3% in 2009 and recognised by the World Bank as one of the highest in the world (WorldBank, 2010) - -

clearly shows why electricity demand in Saudi Arabia is among the highest in the world. Compared to a world average growth in electricity demand of 2.5%, Saudi Arabian electricity demand is increasing 8% annually (IEA, 2009, SEC, 2009). The SEC CEO and President also announced in February 2010 that the demand for electricity varied across the country and in some areas it reached up to 12% (Al-Bishi, 2010).

2.3 Supply-side Issues

Supply-side issues refer to problems relevant to businesses and activities required to secure electricity supplies in a timely manner to meet the growing demand for electricity. Securing electricity supplies to consumers includes activities in generating, transmitting and distributing electricity power to end-users. The SEC, as the dominant player in all these activities, has strived to meet the growing demand since the beginning of its operation in April 2000. The SEC faced its first serious challenge when the approved tariff scheme in April 2000 was replaced after seven months, an action which reduced the SEC's revenues by 30%. The fact that the government adjusted the tariff without providing governmental compensation reduced the SEC's annual revenues by 4,000 million Riyals($1 = SR 3.75). By the end of 2009, this totalled up to 40,000 million Riyals. Therefore, the SEC has struggled to meet the growing demand through placing substantial investments which utilise its available resources (SEC, 2009).

Between 2000 (the start of its operations) and 2009, the SEC invested 160,000 million Riyals to deliver power generation, transmission and distribution projects all over the Kingdom. In its 2009 annual report published in May 2010 (titled "Financing

Challenges 2009 – 2018”), the SEC explicitly, for the first time, suggested that the tariff adjustment that took place in October 2000 had serious consequences including:

- Delaying the execution of several planned power generation projects
- Delaying the execution of interconnection project plans between dispersed areas through principal transmission lines
- The inability to adequately replace aged generating units, transmission lines and substations
- The inability to provide generating reserve margins during peak loads while the normal margin ranges from 15-20%.

The peak load trend that represented the maximum collective demand in the same time was forecasted to increase from 41 - 68 GW for the period 2009 – 2018 (Table 2.5). This increase, therefore, requires an additional one third or more of the current available generating capacities, which must be delivered in a timely manner, otherwise the National Development Plans will face catastrophic risk. This is in addition to replacing aging infrastructure with new transmission lines and distribution networks. The volume of capital investment required to address the challenge of the growing demand for electricity in Saudi Arabia was estimated to be SR 330 billion for the period 2009-2018. Power Generation Projects require SR 173.4 billion, Power Transmission Projects require SR 99 billion and Power Distribution Projects, which the country will be fully electrified by during the predicted plan, require SR 57.5 billion.

Table 2.5: Collective peak load trends in Saudi Arabia for 2009 - 2018

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Source: (SEC, 2009)

The SEC, however, explicitly stated the shortage of funding required for executing the planned projects, as shown in Table 2.6 below. As can be evaluated from the table, the SEC still needs to secure over one third of the required funds to authorise and execute the expansive projects.

Table 2.6: Volumes of secured and required finance in the Power Industry for 2009 – 2018

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Source: (SEC, 2009)

2.4 Saudi Electricity Supply-Demand Challenges – Why is the Gap Widening?

The previous sections and Appendix A presented various relevant issues which have contributed to the pressing challenges facing the Saudi Arabian Electricity Supply industry. A large part of Appendix B analysed the barriers that have impeded the enforcement of essential reform plans that would improve the industry's efficiency. This section will summarise the collective challenges of the investigated industry. These are believed to be strongly contributing to the widening electricity supply-demand gap in Saudi Arabia:

- The electricity tariffs in Saudi Arabia are cheap in a manner that encourages wasteful usage of electricity, whether from residential, industrial or commercial users.
- Saudi Arabia is flooded with inefficient electrical appliances and there is little indication that the entry of these appliances into the Kingdom is being actively prevented.
- Saudi Arabia is experiencing huge industrial and commercial development plans coupled with rapid population growth, driving the electricity demand to even more challenging levels of growth.
- Most of the existing power system infrastructure is aged, in addition to being unable to provide reserve margins during peak loads.
- High levels of uncertainty exist in terms of financing one third of the required supply projects to meet the projected demand for the period 2009 – 2018.

2.5 The SEC project dilemma – on time delivery

Despite the challenges above, and regardless of the recent global economic downturn, the Saudi Arabian power industry was considered a very large investment. As shown in Tables 2.7 and 2.8, many projects have been executed by the SEC (Table 2.7) and the private sector (Table 2.8) that have recently entered into service.

Table 2.7: Projects executed by the SEC

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Table 2.8: Projects executed by the Private Sector

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Illustration removed for copyright restrictions

There are also many large power generation and transmission projects that have been approved to be executed by the SEC and the private sector, as shown in Tables 2.9 – 2.11.

Table 2.9: Planned projects that will be executed by the SEC and Private Sector

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Table 2.10: Planned projects and approved to be executed by the Private Sector

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Table 2.11: Connecting Transmission Line projects in the Kingdom

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There are also more than 250 transmission substation projects of 132kV, 115kV, and 110kV capacity spread over the Kingdom. This is in addition to distribution level (69kV and below) substations to electrify rural areas and support urban systems. In 2009 alone, the total capital investment in the SEC's budget was about SR 18.732 billion when 206 new projects were authorised to expand and support the existing Electric Power System. The demand trend has proven that there will be even more projects needed to cope with the growing demand for electricity.

The electricity supply industry in Saudi Arabia is already facing uncertainty over securing proper funds to finance future necessary projects. Authorised projects, where relevant funds have already been allocated, must be executed in a timely manner to meet, at least partially, the country's need for electricity. Projects in the investigated industry were normally delivered, but at a point which was often well beyond the expected delivery date. This fact indicates that the delays in completing the continuously developing infrastructure accommodating newly delivered projects have the potential to widen the supply-demand gap even further. If this observation were to be left without proper attention, the largest oil exporter the world has ever known could face unwanted consequences affecting its national economic growth and social wellbeing.

This research adopted a macro-level view in which the concern was to provide the electricity consumers with adequate and sufficient supplies in a timely manner and without interruption. Therefore, the central concern of this study was to consider how to deliver the SEC authorised projects on time. Delivering projects on time in Saudi Arabia was proven to be of deep concern for the government. This was especially true when a recent study revealed that 65% of public projects were managed without an established time schedule (Alhilali, 2011). The remaining 35% had time schedules but were not necessarily delivered on time. In this context, comprehending the surrounding causes and factors impeding these authorised projects from being delivered as planned will provide information of strategic value to the SEC, specifically, and for the entire Saudi Arabian electricity industry in general. A starting point for this study, based on the literature discussion so far, will be the consideration of the following research question:

> **What are the project delay factors in the Saudi Arabian electricity supply industry?**

While the study seeks to identify the project delay factors, the research will also explore the following relevant sub-questions:

How frequently do the identified project delay factors occur in the investigated industry?

To what extent do these factors delay projects in the investigated industry?

How significant and important are these project delay factors?

Projects normally go through varying difficulties and problems after being conceptualised. In such a sensitive industry, projects are of high urgency and, therefore, they must be delivered with maximum efficiency. The SEC was established in 2000 but has collective project experience of over five decades. Yet, projects were still being reported as being delayed, affecting the SEC strategic objectives. Identifying and understanding project progress delaying factors will enable strategic officers and project management practitioners in the Saudi Arabian electricity supply industry to conceptualise the collective challenges formed by these factors. The resultant conceptual model of Project Implementation Challenges will dictate project stakeholders' actions to overcome these challenges in order to improve the project delivery rate in the industry.

2.6 The Saudi Electricity Company – the Project Owner

The share capital of the SEC is distributed as follows: the government holds 74.31% of the Company, 6.93% is owned by the giant national oil company Saudi Aramco and 18.76% is owned by other private shareholders. One form of the Saudi Arabian government subsidies to the SEC was not to claim its share of dividends for ten years from the date of the Company's foundation in 2000. This was recently extended for another ten years according to Decree No. 327 issued by the Council of Ministers on 14th September, 2009 (SEC, 2009). Saudi Aramco raised a claim for its share of yearly cash dividends for the period 5th April, 2000 (the inception of the Company) to 31st December, 2008 which amounted to 1,533 million Riyals. The SEC, however, believed that since Saudi Aramco is a wholly owned government organisation, it had no right for such a claim (SEC, 2009). The government has also provided interest-free loans to the Company to authorise pending projects. These financial supports, however, were not sufficient to pursue the Company's highly expensive operations and authorise appropriate projects. Despite the various challenges surrounding the electricity industry described previously, the SEC has still managed to make enormous progress over the last decade (2000-2009). Its impressive achievements are documented in Table 2.12 below.

Table 2.12: The SEC achievements until the end of 2009

Aston University

Illustration removed for copyright restrictions

Source: (SEC, 2009)

2.6.1 The SEC Organisational Segments

At the inception of the SEC following the completion of the merging of all electric utilities in the Kingdom, the SEC undertook a gradual approach towards restructuring its business functions. First, the Company was divided into branches based on geographical locations, which principally operated in a similar manner before the inception of the SEC (SEC, 2003). The main difference was the appointment of the CEO and the setting up of a temporary Executive Committee empowered with specific tasks by type of business (i.e. Power Generation, Power Transmission, Power Distribution, Finance, Human Resources, Legal Affairs etc.). The Executive Committee supervised the work of all Branches and sought to implement a unified code of practice, operating procedures and guidelines before implementing the transitional organisational structure in June 2002. The organisational structure at present is based on the Company's main functional businesses (Figure 2.1). The SEC today is divided into the three main activities of Generation, Transmission and Distribution (Figure 2.2). There are also other related supporting activities of Finance, Legal Affairs, Contracting, Public Affair and Shareholder Relations, Human Resources, Internal Auditing and General Services.

Figure 2.1: The SEC organisational structure from prior inception to the end of 2010 (SEC, 2003)

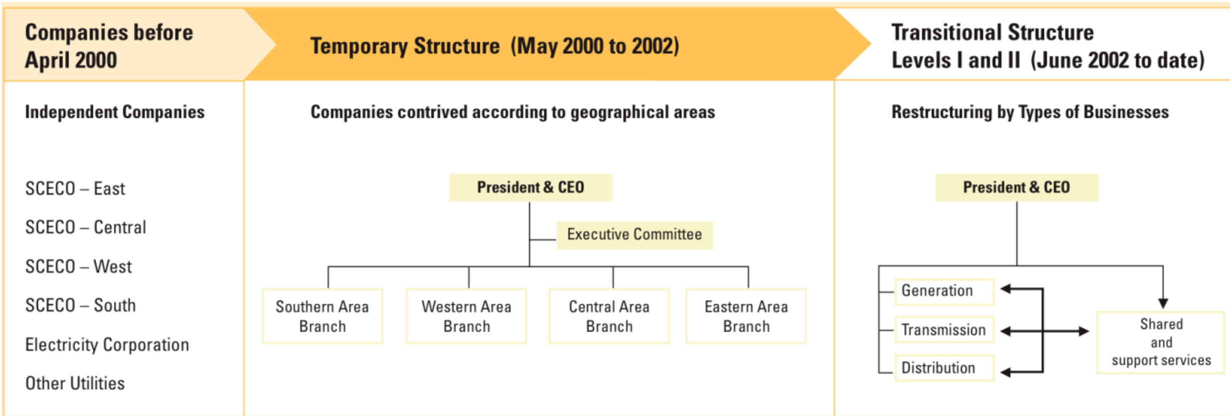
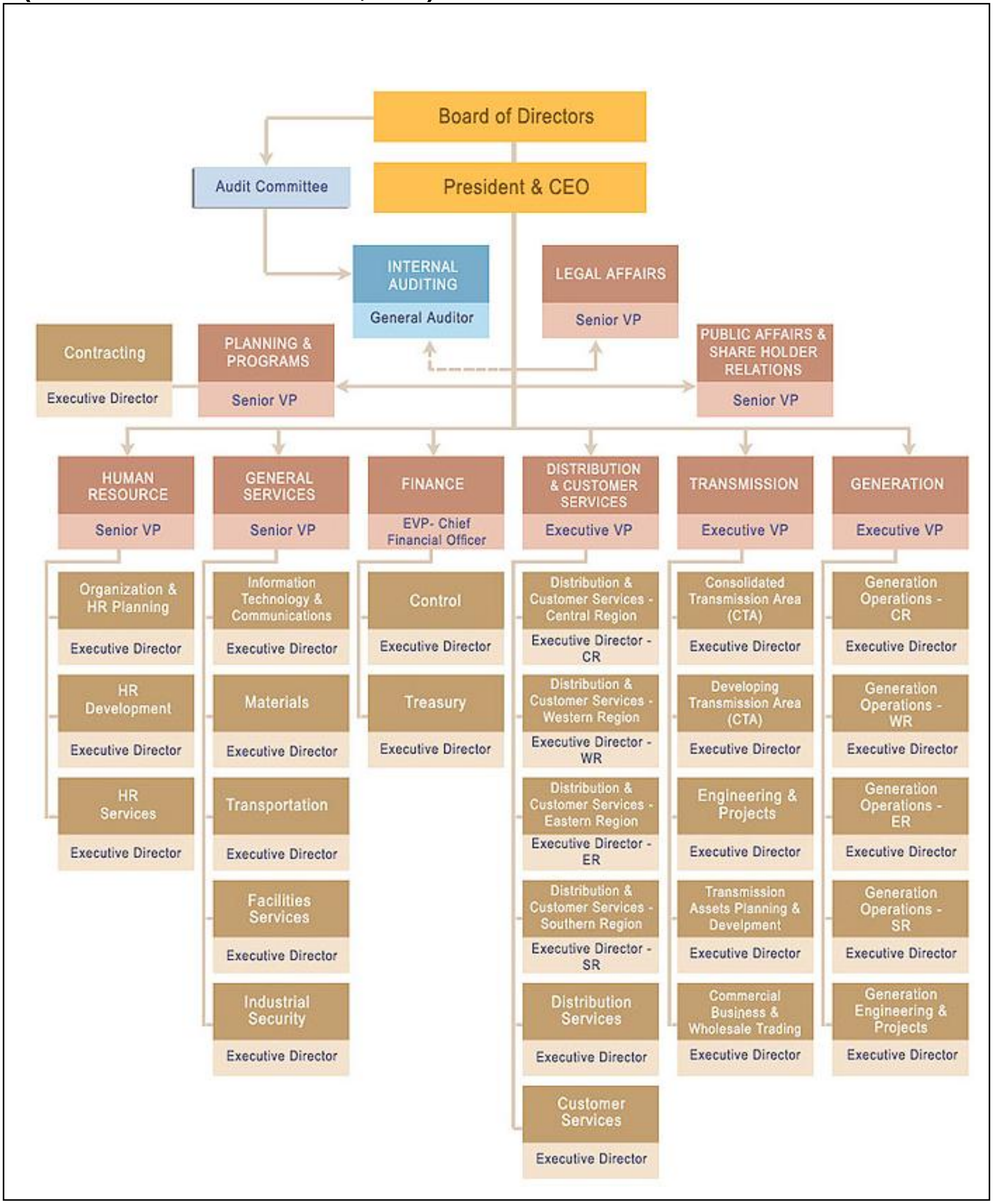


Figure 2.2: The SEC organisational structure

(Source: SEC official website, 2010)



2.6.2 The SEC Key Project Departments

Generation, Transmission and Distribution activities complement each other for the purpose of delivering the electricity to the consumer and, therefore, supply projects occur within these three sectors (SEC, 2009). Each of these activity sectors are represented by an Executive Vice President (EVP) who oversees all relevant operational and project activities in all four operational areas (Central, Western, Eastern and Southern) (Figure 2.2). The research is mainly concerned with management Departments that deal with developing projects from inception to closure. In other words, the investigation is focused on these Departments in which each has a key contribution to make in transforming a project from a ‘concept’ to an operating ‘product’. Concentrating on these key Departments will assist in comprehending the nature of the Project Implementation Challenges since these are the entities that captured the most relevant events and incidents that impeded project progress. There are many other Departments which each have a certain degree of involvement in developing a project. Most of these will be referred to when describing the project lifecycle below. As will be mentioned in the methodology Chapter 4, the only available organisational structure chart was Figure 2.2. Therefore, the details herein which describe the key Departments involved in developing projects are part of the primary data collection. The description will also focus on the Western Operating Area where the data were collected. These Departments were, however, structured similarly in all other areas. The key Project Departments existing in all three activities of Power Generation, Power Transmission and Power Distribution are Project Planning Department (Project Planning Division in Power Distribution), Project Specifications and Design Department (Technical Support in Power Distribution) and Project Execution Department (Project Execution Division in Power Distribution) (Figure 2.3 – 2.5).

Figure 2.3: Key Project Departments in the SEC – Power Generation

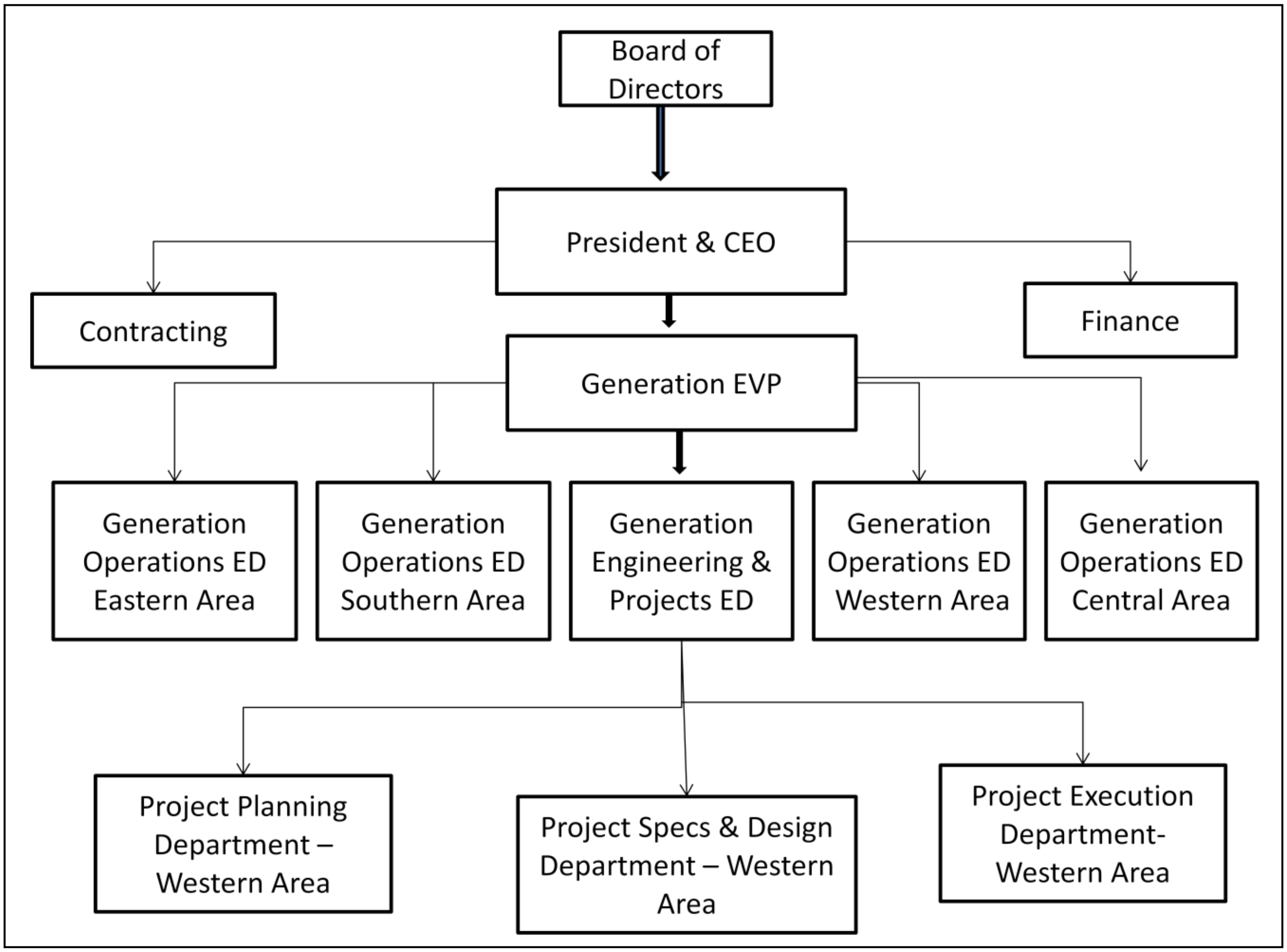


Figure 2.4: Key Project Departments in the SEC – Power Transmission

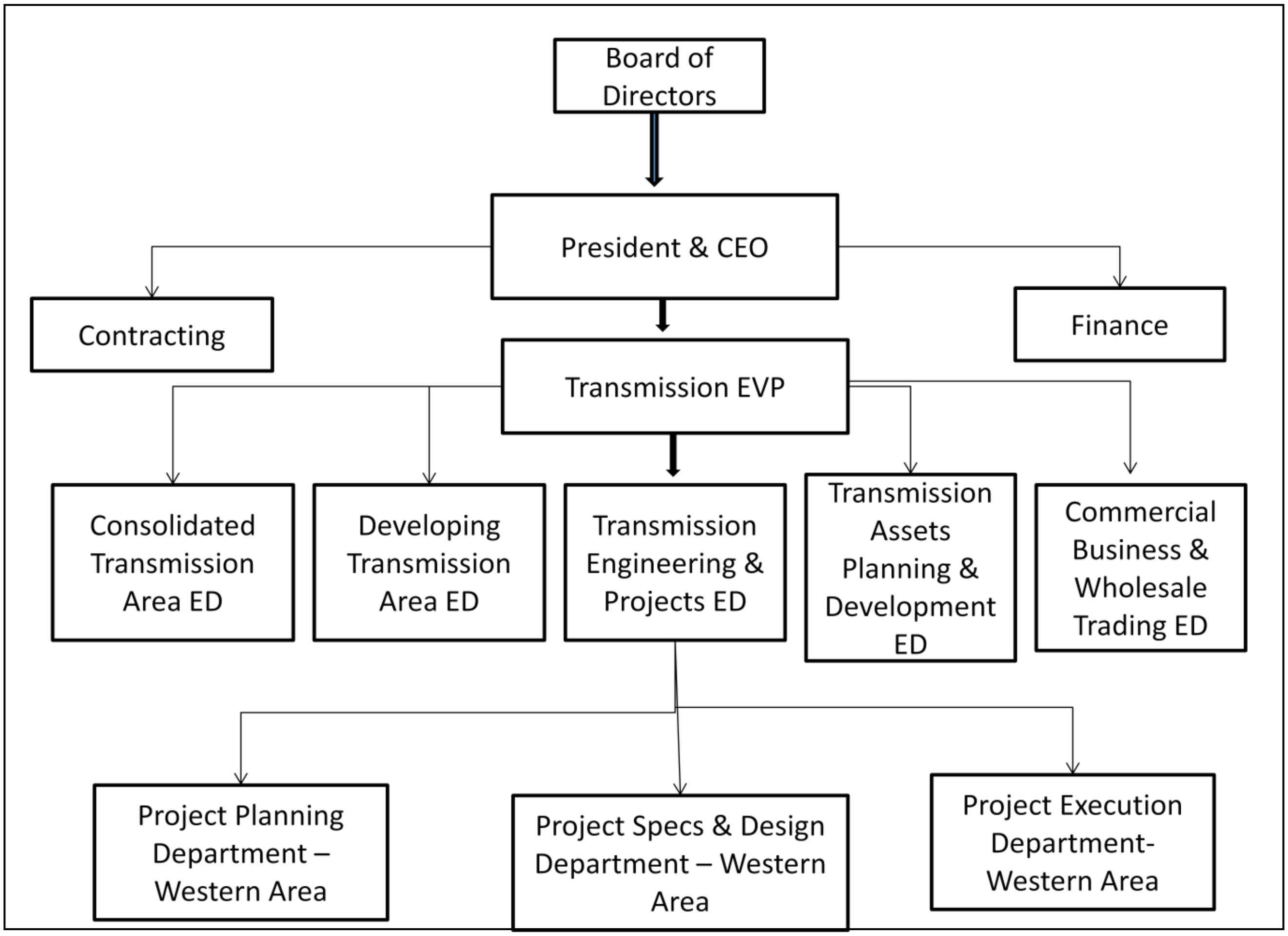
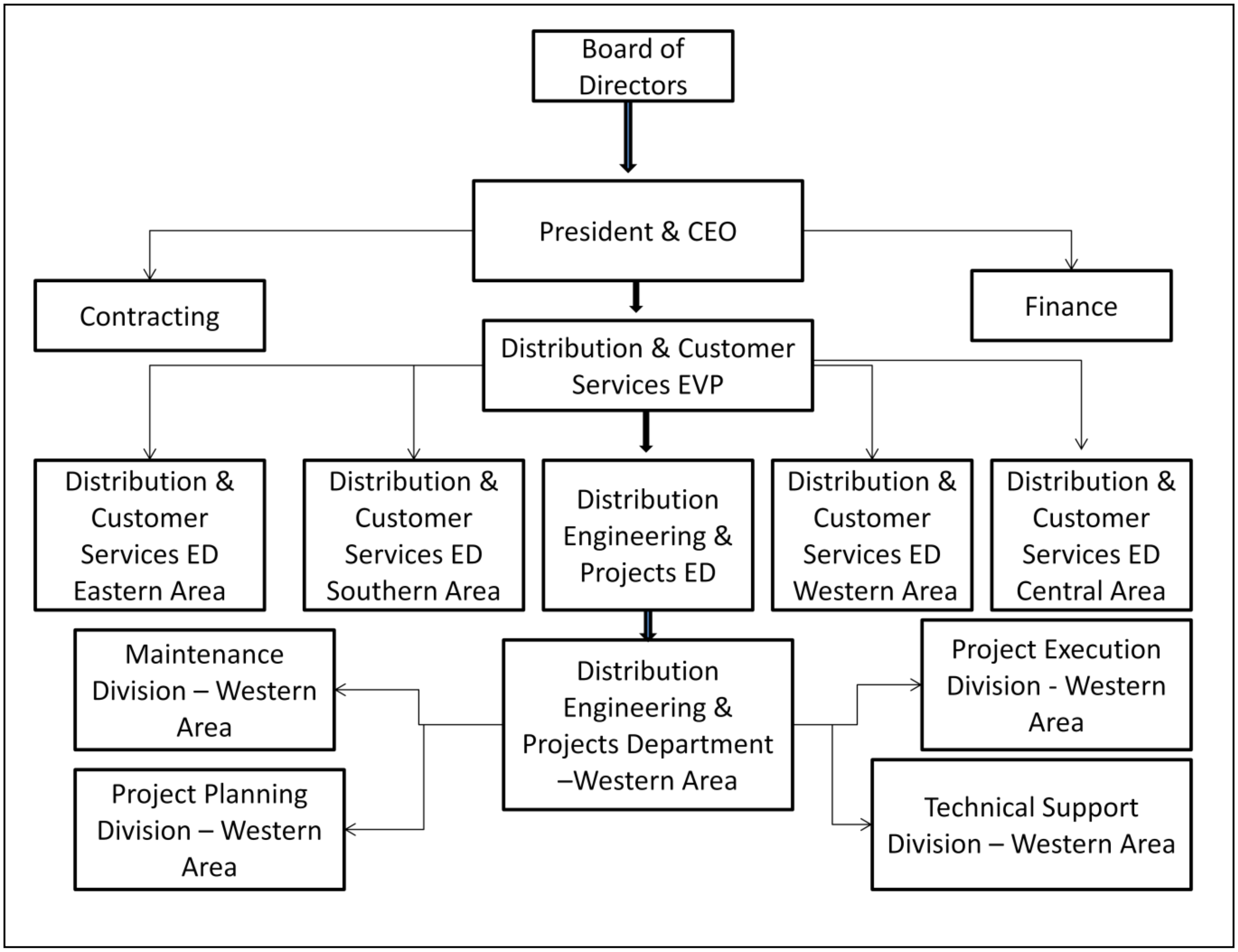


Figure 2.5: Key Project Departments and Divisions in the SEC – Power Distribution



2.6.2.1 Project Planning Department

The following describes the relevant tasks identified in the conducted interviews in all Project Planning Departments (or Project Planning Division in Power Distribution) unless otherwise stated:

- Analyse on a periodical basis the load direction and growth in order to forecast the electricity demand volume within its Working Area (in Power Generation (PG));
- Evaluate the best economical options to provide electric power services;

- Evaluate the impact of heavy consumers with large demand in the future on the main grid and distribution networks (in Power Transmission (PT) and Power Distribution (PD));
- Coordinate with large electricity providers (Saudi Water and Electricity Company, Marafiq, Saudi Aramco, SABIC etc.) to analyse the required additional utilities (PG and PT);
- Estimate the required additional generating and transmission network capacities to meet the forecast demand and estimate the urgency of these projects (PG and PT);
- Estimate the required capital investment volume to deliver the needed utilities (power plants, power transmission overhead lines, distribution networks etc.) and conduct related financial analysis and secure authorised signatures to allocate the adequate cash flow to finance these projects;
- Coordinate with Finance Department to prepare project budgets for allocation;
- Survey potential project sites;
- Coordinate with Asset Management Department to purchase or lease project sites;
- Coordinate with relevant government authorities to share any conceived developmental project plans owned by these authorities in order to analyse their impact on the SEC planned projects;
- Issuance of required project work permits by the relevant authorities;
- Arrange the primary scope of each project by providing the basic drawings and schematics;
- Monitor the financial performance of projects under execution and update project estimate parameters for future use.

2.6.2.2 Project Specifications and Design Department

The following describes the relevant tasks identified in the conducted interviews in all Project Specifications and Design Departments (or Technical Support Division in Power Distribution) unless otherwise stated:

- Place engineering standards of the electrical devices and equipment by studying and analysing the properties of the state-of-the-art equipment and systems available in the market to promote existing systems of the SEC;
- Prepare project designs for both brand-new or expansion projects in accordance with the SEC's specification standards in coordination with the relevant Project Proponents - mainly the Operations Departments in the same sector. This is pursued through elaborating the primary project scope provided by the Project Planning Department;
- Participate in corresponding with bidders as a member in the Offer Analysis Committee to answer any technical inquiries;
- Analyse bidders technical offers in detail and assess whether these matched with the SEC requirements and standards;

- Address any concerning technical deviations in bidders offers;
- Solve any technical confusion between the SEC and bidders;
- Coordinate with large Consumers' Specifications Departments (such as Saudi Aramco and steel manufacturers) to ensure that their systems and devices are adaptable to the SEC's system.

2.6.2.3 Project Execution Department

The following tasks were performed by Project Execution Departments (or Project Execution Division in PD) in all three activity sectors:

- Monitor the Contractor's project execution performance in accordance with the binding contract;
- Coordinate with the Contractor to submit the relevant engineering drawings and designs for approval;
- Coordinate with the Consultant engineer to review the Contractor's technical submittals;
- Review both technical and financial aspects progress with the Contractor and the Consultant and prepare periodical progress reports;
- Monitor the progress of manufacturing, shipping, supplying and testing the equipment with the Contractor;
- Prepare the relevant letters addressed internally (within the SEC) and externally to progress the relevant project activities;
- Review Contractor and Consultant submitted invoices and coordinate with Finance Department to progress the payments;
- Coordinate with the Operations Department (Project Proponent) to attend the equipment testing to issue their technical approval and acceptance;
- Coordinate with the Operations Department to secure necessary power system shut down for commissioning the project into the SEC system.

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2.6.3 Development of Electricity Supply Projects in the SEC

The following describes the development stages of electricity supply projects in the SEC and the interaction between various project stakeholders.

2.6.3.1 Project inception

After estimating the required additional generating, transmission and distribution network capacities to cope with the increasing demand of electricity, the relevant Project Planning Department develops the primary scope of each project. This is followed by providing initial estimates of the project resource requirements. The same Department then surveys potential project sites and the financial resource estimates are updated. This is followed by coordinating with the Assets Management Department after securing the required project budget to purchase the project site. The project is then handed over to the Project Specifications and Design Department to elaborate on the basic project primary scope developed by the Project Planning Department and to develop the technical requirements with further details to arrange the Bid Package.

2.6.3.2 Developing the bid package

A bid package consists of a detailed description of the project work to be performed by the awarded Contractor. This includes the technical specifications of the procured equipment and systems with sufficient and clear details. In addition to the relevant drawings and schematics, a bid package includes all other documents containing the terms and conditions which are necessary for the bidders to prepare their proposals. The Project Specifications and Design Department is responsible for providing the detailed scope of work and the technical information of the proposed project. It also coordinates with the project operator (Project Proponent) to review the detailed project scope of work and secure the Project Proponent’s acceptance. The Contracting Department is responsible for preparing and completing the Bid Package which also includes written instructions, contract terms and conditions and contractual obligations for both contracting parties. The Contracting Department also reviews financially relevant terms with the Finance Department. The Bid Package is considered the basis on which all bidders prepare both financial and technical proposals. Therefore, it is necessary to ensure that the Bid Package is developed as carefully and as clearly as possible.

2.6.3.3 Advertisement for prequalification

The following statement is one of the SEC's general contracting and purchasing policies:

> [The] Company shall adhere to the suitable methods of work including giving fair chance to all manufacturers, contractors, suppliers and individuals to compete to satisfy [the] Company's different needs. Clarity and transparency shall be observed in taking the decisions related to Contracts or Purchase orders awarding and settling disputes. SEC employees performing work on its behalf shall avoid all situations in which their personal interests might conflict with [the] Company's interests.

Therefore, the Company advertises the proposed project contract in local newspapers, on bulletin boards in the SEC areas normally visited by contractors and on the Company's official website. For large and complex project contracts with estimated values of greater than 50 million Riyals, the Contracting Department also advertises the proposed project contract in international newspapers and magazines. These projects (i.e. constructing power plants, transmission lines, substations etc.) are normally constructed on a turnkey basis. The SEC employs a prequalification process to identify contractors with adequate technical and financial resources to perform the relevant activities within the required time schedule. Both the Contracting Department and the Project Proponent establish prequalification criteria that are used to determine whether or not a bidder is capable of performing the project. The criteria involve both technical and financial considerations. The technical criteria includes whether the bidder has sound organisation structure and relevant experience with similar work. The criteria also consider whether the bidder has sufficient manpower and equipment resources that are ready to deploy once the project is awarded. Performance on other contracts with the SEC is also highly regarded since bidders must not have had any ‘unsatisfactory performance ratings’ within a year from the prequalification request announcement. The Contracting Department also ensures that a bidder has adequate financial resources that will meet the project requirements.

2.6.3.4 Bid review and evaluation

The qualified bidders examine in greater detail whether the contract is achievable with regard to their available and accessible resources. These bidders review the SEC’s initial requirements to better estimate their available manpower, financial and machinery resources. After going through a ‘bid’, or a ‘no bid’ process, bidders who decide to bid then purchase the bid package from the SEC Contracting Department to carefully study the technical and financial requirements to further estimate the project activities and plan for the necessary resources. The bidders also conduct site visits to improve the certainty level of the required resources for delivering the project.

According to the SEC general contracting and purchasing policies, openly competitive bidding is the primary method of procuring SEC contracts. This method, presumably, enhances the chance of selecting the best contractor for the work. This will allow the SEC to obtain the best combination of lowest prices, best technology and work execution plan (SEC Contracting Manual). To address any mistakes, inconsistencies or unclear issues in the bid package, the SEC conducts a Job Explanation Meeting with the invited bidders to explain in detail the contract requirements. After conducting these activities, bidders should be ready to develop their technical and financial offers and submit their offers to the SEC Contracting Department.

The bids are then opened by the Bid Opening Committee in the presence of the bidders. The bid of the lowest bidder is subject to an intensive review by the Bid Review and Evaluation Team composed of a Contracting Department representative, a Project Specifications and Design Department representative and a Project Proponent representative. If the bid includes any major deviations from the required technical specifications or work requirements, the bidder will be given the opportunity to either clarify his position (i.e. whether the deviation will serve the SEC's best interests or not) or withdraw his deviations. If the position cannot be clarified, the lowest bidder will be considered as non-complying and therefore as not acceptable. The bid of the second lowest bidder will then be considered and the procedure described above will be repeated until an acceptable bid is determined.

2.6.3.5 Project award

After determining the acceptable bid, the Bid Review and Evaluation Team writes its conclusions and recommendations in a summary document known as the 'Award Recommendation'. This provides a complete justification for the recommendation with an accurate record of the review and evaluation process. This Award Recommendation is then forwarded to the figure authorised to sign the contract known as the 'Signature Authority'. The contract value determines the Signature Authority level and this can be the Proponent Department Manager, the Proponent Executive Director, the Proponent Vice President, the Proponent Executive Vice President, the CEO or the Board of Directors. After securing the Signature Authority approval, the successful bidder receives an official notification to sign the binding contract with the SEC and initiate the procurement activities.

2.6.3.6 Project execution and closure

The Contracting Department submits a copy of the awarded and signed contract to the Project Execution Department. The Project Execution Department is responsible for monitoring the Contractor's performance and ensures the adherence to the contract's articles and clauses. A kick-off meeting takes place between the SEC Project Execution Department (Department Manager and appointed Project Manager representing the SEC), the Contractor's representatives (an Executive Manager if applicable in addition to the Project Manager representing the Contractor) and the SEC's Consultant engineer. The kick-off meeting establishes a common understanding between the parties as to how the project will proceed. In this meeting, the Contractor submits his project organisational chart with sufficient contact details of the team members. He also submits the project execution schedule plan which includes an overall statement of how the project will be carried out with details of project milestones and their delivery dates. The meeting also clarifies project procedures including the submittal format and the timetable of future project review meetings.

The Contractor then takes over the project site from the SEC and mobilises the manpower and equipment and starts executing the project contract. In the initial phase of the project execution, the engineering design dominates the project workload. The Contractor, with an outsourced engineering design service, elaborates on the technical drawings and schematics in the bid package. The designs are then carefully reviewed by the Consultant engineer outsourced by the SEC. These drawings cover many work disciplines such as electrical, mechanical and civil work. After approving these drawings, the Contractor executes all sequenced activities based on the drawings. As a quality control procedure, the SEC prevents the Contractor from proceeding with any activity or placing any order for equipment or material without securing the SEC's formal approval.

The SEC relies on their outsourced Consultant engineers to make technical decisions before approving or rejecting the Contractor's submittals. The only exception is in Power Distribution where the SEC relies on in-house engineers for technical decisions on the Contractor's submittals. Making timely decisions on these submittals is important for the Contactor to proceed, if approved, and place orders for the relevant equipment. This is especially important when considering the fact that large pieces of equipment take a long time to manufacture.

While the manufacturing processes for major pieces of equipment are in progress (such as gas or steam turbines, boilers, transformers, switchgears, cables, etc.), the civil work takes place (such as foundations, cable trenches, lighting, etc.) to prepare the project site to accommodate the manufactured and delivered equipment. The manufacturers and suppliers notify the Contractor of the manufacturing progress and delivery status on a regular basis. Just before major pieces of equipment reach the final stages of manufacturing, the Contractor Project Manager notifies the SEC Project Manager to arrange a factory visit. Once manufactured, the SEC performs a 'Manufacturing Inspection' which is attended by the SEC Project Manager, the SEC Project Proponent and the Contractor Project Manager. If the equipment passes the inspection, the SEC Project Manager issues a 'Shipment Release' letter. The equipment is tested again at the project site before being installed and interconnected with other pieces into an integrated system. Then, the whole system, after all other pieces have been interconnected, is tested before incorporating the system (or project) into the SEC operating electric power system.

If this new, isolated system proves to be technically viable and passes the pre-commissioning tests in the presence of the relevant inspectors, a Technical Completion Certificate is issued for the Contractor indicating the project is ready for commissioning and operation. This is when the SEC's Contractor Project Manager issues a request to the SEC Project Manager to arrange for a major shutdown of the electric power system that will accommodate the new project product. After the project becomes fully operational, the SEC Project Manager issues a Preliminary Acceptance Certificate and this is when the warranty period of the project starts.

Finally, the Contractor works on delivering the punch items list to secure the Final Acceptance Certificate and release the final payment instalment. These items, such as placing the nameplates on the feeders and transformers, providing missing spare parts, finishing painting works, etc., do not interrupt the project operation if they are not delivered. The project is then officially considered closed and terminated after issuance of the Final Acceptance Certificate and when the warranty period comes to an end.

2.6.3.7 Concluding Remarks

The above is a brief description of an ideal project development in the Saudi Arabian electricity supply industry. In reality, however, there are many more details that interrupt the steady execution of a project. Given the unique features of projects where every project has its distinguishing story, this adds to the challenge facing this study's attempt to comprehend the factors impeding project progress. One source of strength for this research, however, is restricting the inquiry context to a specific set of social actors (Project Owner, Project Contractor and Project Consultants) in a specific industry. Knowing that the Project Owner represents only one, though large, organisation (the SEC - Western Operating Area) is considered an additional strength for this study. This is because the working relationship culture is likely to emerge more quickly and be easier to capture when compared to working with several Project Owners with different organisational forces and, hence, cultures. The next step this research project needs to take towards conceptualising the PICs will be identifying the most important factors impeding steady project progress in the industry (PDFs).

3. The Role of Project and Project Management in Organisations

3.1 Introduction

The first chapter presented the global concern to secure adequate energy supplies to maintain the world's economic growth. It also acknowledged the potential challenges facing Saudi Arabia to meet its local demand for electricity despite its ownership of substantial reserves and massive production levels of fossil fuels. The second chapter described the general and most pressing challenges facing its need to meet its local demand for electricity. One crucial means to meet the rapidly growing demand for electricity in Saudi Arabia is through authorising supply projects to increase the country's electricity production levels. After acknowledging that project delay was noticed to be not only a major problem in the industry but also an accepted phenomenon, this chapter reviews the relevant literature surrounding the research questions and objectives to set the study within its wider context. After defining the key terms, this chapter will reflect on the relevant studies addressing project delay factors in the construction industry and state the knowledge gaps which this study would bridge.

3.2 Projects and Project Management

Project management is a mature and well-developed discipline for the exercise of professional expertise and for academic research. Therefore, a great number of authors and scholars have attempted to define "project" and "project management" in many different ways. For example, Gray and Larson (2008) define project as "a complex, non-routine, one-time effort limited by time, budget, resources, and performance specifications designed to meet customer needs" (Gray and Larson, 2008). Pinto (2007) defines a project as

> any series of activities and tasks that: have a specific objective to be completed within certain specifications, have defined start and end dates, have funding limits (if applicable), consume human and nonhuman resources (i.e., money, people, equipment), and are multifunctional (i.e., cut across several functional lines).
>
> (Pinto, 2007)

Cleland and Ireland (2007) state that a project is "a combination of organisational resources pulled together to create something that did not previously exist and that will provide a performance capability in the design and execution of organisational strategies" (Cleland and Ireland, 2007). Finally, the Project Management Body of Knowledge (PMBoK) guide of the Project Management Institute (PMI) has defined a project as "a temporary endeavour undertaken to create a unique product, service, or result" (PMI, 2004). Pinto (2007) refers to this definition as the simplest which was formulated by the largest professional project management association, with over 285,000 members worldwide as of March 2009.

The above definitions that when organisations need to implement their strategic plans to achieve their goals, some required activities cannot be addressed within normal organisational capabilities. To achieve these goals, projects are authorised in these typical situations as the vehicle for creating organisational change (Anderson et al., 2006, PMI, 2004). The common themes emerging from the definitions quoted above reveal that a project is a vehicle to achieve a unique outcome, whether a product, a result or a service, which was conceptualised and authorised by customers using available resources within previously decided parameters of scope, time and budget.

The discipline that deals with projects from their inception to closure is widely known as “Project Management”. Cleland and Ireland (2007) have defined the discipline as

> a series of activities embodied in a process of getting things done on a project by working with members of the project team and with other people (stakeholders) in order to reach the project schedule, cost, and technical performance objectives.
>
> (Cleland and Ireland, 2007)

For the purpose of this research, the adopted definition of “project management” was the one defined by the PMBoK of the PMI: “project management is the application of knowledge, skills, tools and techniques to project activities to meet project requirements” (PMI, 2004).

3.3 Programmes and Programme Management

The above “project” definitions suggest that projects are undertaken in many industries and in different cultures. Moreover, many organisations manage several projects simultaneously. Such collections of projects are normally referred to as “programmes”. “A programme is a group of related projects managed in a coordinated way to obtain benefits and control not available from managing them individually” (PMI, 2008). Therefore, programmes provide a means to bridge the gap between project delivery and organisational strategy (Lycett et al., 2004). For example, one of the Saudi Electricity Company’s strategic objectives is to electrify rural areas dispersed all over the Kingdom. Therefore, to help achieve this strategic goal, the electrification programme has been broken-up into many power generation projects, power transmission projects and distribution network projects (see Chapter 2 and Appendix A for details on this).

The above suggests that programme management is observed as an evolution of project management, with the main purpose of such management being to cope with the holistic, complex change brought by these groups of projects or programmes (Morris, 1994, Morris, 2009, Pellegrinelli, 2011). Therefore "programmes" were viewed as an efficient vehicles to deliver organisational improvements and changes (Shehu and Akintoye, 2010) - without a strong priority system linked to strategy, problems would otherwise be created in the implementation of projects (Larson and Gray, 2011).

"Programme management is the integration and management of a group of related projects with the intent of achieving benefits that would not have been realised had the projects been managed independently" (Lycett et al., 2004). This indicates that programme management has benefits which include the following:

- It improves the linkage between strategic objectives of organisations and the management activities – including project management - required to achieve these strategic objectives
- It improves project definition to avoid project scope creep
- It improves communication of overall goals and activities within and between projects
- It embraces more effective knowledge transfer through improving the capturing of transferable lessons. A holistic overview of projects will lead to identifying a trend of persisting problematic issues that could be noticed and, hence, enable practitioners to provide more practical solutions.

However, there are flawed assumptions, such as the following, which underlie programme management: programme management is a scaled-up version of project management (Morris, 2009, Pellegrinelli, 2011, Artto et al., 2009, Lycett et al., 2004); and a "one size fits all" approach to programme management is appropriate (Lycett et al., 2004, Shenhar, 2001). Programme management addresses the contents and contexts of organisational change in a manner that heavily involves other managerial disciplines (Pellegrinelli, 2011). This obviously suggests that programme management is not a simple scaled-up version of project management and, therefore, the challenges faced in programmes are viewed as compounded and more complex when compared to those faced in projects.

3.4 Project Characterisation

The wide range of projects has invited scholars to undertake a common approach to the management of all projects in the programmes. This has been perceived as a wise initiative since organisations can maximise the available resources through, for example, enforcing comparable progress reporting and consistent calculation of resource requirements enabling sharing of resources. This will also ease the movement of project team members between projects within the programmes without having to learn a new management approach (Payne and Turner, 1999). Therefore, there is a need to identify project characteristics in which project attributes and types are comprehended.

Kerzner (2009) and Crawford et al. (2005) identified a list of attributes that can be used for characterising projects, but they also emphasised that the list can consist of endless attributes (Crawford et al., 2005, Kerzner, 2009). Listed below are some of the most common attributes identified in the literature (Muller and Turner, 2007b, Muller and Turner, 2007a, Zwikael et al., 2005, Cooke-Davies and Arzymanow, 2003, Shenhar et al., 2001, Kerzner, 2009):

- Application area: projects are undertaken in several application areas and industries including in-house R & D, small construction, large construction, aerospace and defence, engineering and many others (Kerzner, 2009). A field study by (Cooke-Davies and Arzymanow, 2003) which conducted an inter-industry comparison of project management practices, showed that differences occurred not only between project practices across industries, but also between organisations within a single industry. The most highly developed project management practices were in the Petrochemical and Defence industries when compared to Pharmaceutical R & D, construction, telecommunications and the financial services industries.

- Strategic importance: organisations often classify projects based on their urgency. Projects with high urgency, often described as emergency projects, are highly visible to top management. For example, the Saudi Electricity Company has recently authorised a number of emergency projects to secure adequate electricity supplies to areas that suffered several inconvenient service interruptions. The urgency of these projects forced the government to intervene by providing the SEC with urgent funds and authorising these necessary supply projects.

- Technological complexity: arguably, the material and equipment technologies involved in projects differ from one industry to another and from one culture to another. The pharmaceutical, information systems and manufacturing industries develop at a faster rate than those in the construction and utilities industries. Shenhar et al (2001) have categorised projects based on the level of technological uncertainty evaluated at the project initiation stage (Shenhar *et al*., 2001). Such a grouping was proven to be an important independent project variable (Shenhar, 2001). The more advanced the material or equipment technology used in a project, the more likely budget and schedule overruns were to occur. The suggested project types were as follows (Shenhar *et al*., 2001):

1) "Low-tech projects which rely on existing and slowly developing technologies such as construction and road building where a contractor rebuilds an existing product;
2) Medium-tech projects which rely mainly on existing technologies but incorporate some new features (for example, industrial projects of incremental improvement and modifications of existing products);
3) High-tech projects in which most of the technologies developed are newly built but based on existing products such as new computer families and defence developments;
4) Super high-tech projects which are relatively rare and based on new and as yet non-existent technologies which must be developed during project execution".

Shenhar *et al.*'s (2001) project grouping above also indicates that projects involved with a lower level of technology had a more rigid scope and design when compared to projects involved with higher level technology. For the purpose of this research, the project type that will be investigated could be considered to be medium-tech projects. Projects in the electricity supply industry (Power Generation, Power Transmission and Power Distribution Projects) are highly involved with construction work and these are well established and mature project fields. However, a large portion of these power projects also involve equipment that continuously faces incremental advancement in their procured products when compared with normal building construction materials and equipment (Nye, 2004, Mazer, 2007). ‘Generating turbine’ manufacturers, for example, continuously strive to enhance the energy conversion efficiency to reduce the required fuel to generate the same amount of electricity and minimise waste energy (Breeze, 2005). Power Transmission control systems are also continuously equipped with additional features to improve the electricity supply-demand management in the grid. Power Distribution substation protection systems are always enabled with improved and developed features to extend the lifetime expectancy under abnormal operational conditions (Aron, 2007).

It could be easily argued in today’s business environment that all technology levels (low-high) are exponentially advancing. This research project, however, is concerned with Shenhar *et al.*’s (2001) project type grouping based on project technology level, because this requires project team members with a certain set of skills and relevant knowledge of the project technology. In other words, the higher the level of project technology involved in a project, the more likely skilful manpower is required to manage and deliver the project. This is especially true knowing that project specifications and design rigidity is more flexible towards higher technology projects during the execution phase, increasing the uncertainty level of project outcomes.

3.5 Projects and Project Management Success

The ultimate goal for all project management practitioners is to deliver projects successfully. It was evident, previously, that project definitions all circulate around a project being a temporary activity to deliver a specific result within an allocated budget and specific time-frame. Therefore, it might easily be assumed that the concept of project success could be limited to meeting these three constraints of project scope (specific result), project time (temporary activity) and project cost (allocated budget). This would be true if this perception were limited to project management professionals who were directly responsible for managing all the relevant activities to turn a project from a concept into an operating product or tangible result or service. However, project outcomes are also assessed and valued by other project stakeholders. PMI (2004) note that

> Project stakeholders are individuals and organisations that are actively involved in the project, or whose interest may be affected as a result of project completion. They may also exert influence over the project's objectives and outcomes.
>
> (PMI, 2004)

Therefore, measuring project success involves an assessment of which project objectives have been delivered as they are perceived by all project stakeholders involved (Thomas and Fernandez, 2008, Mallak et al., 1991, Williams, 2002, Wit, 1988). Project stakeholders can be categorised as shown in Figure 3.1 (Mallak *et al*., 1991):

Figure 3.1: Project stakeholders (Mallak *et al*., 1991)

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The concept of success in projects has been extensively discussed in the literature of project management (Thomas and Fernandez, 2008, Anderson et al., 2006, Baccarini, 1999, Jugdev and Muller, 2005, Mallak et al., 1991, Munns and Bjeirmi, 1996, Wit, 1988). Although Mallak *et al*. (1991) admitted that satisfying all project stakeholders is a compromise, they elaborated on how to satisfy each category by considering the main interests of each stakeholders in the project and then evaluating the extent of their influence on the project's progress. The likely differences between these stakeholders, therefore, make it difficult to achieve steady project implementation. For example, the authorities and regulatory agencies, such as municipalities, are responsible for enforcing building codes in construction projects. Therefore, project owners and contractors seek to minimise any potential problems with municipalities by complying with these codes which could be under continuous adjustment and change.

Given the unique nature of each individual project (Anderson et al., 2006, Belassi and Tukel, 1996), considering the project interests of all stakeholders makes it difficult to objectively measure project success (Thomas and Fernandez, 2008, Wit, 1988). The difficult task of defining project success was addressed in the PMI Annual Seminars and Symposium in 1986 (Baccarini, 1999):

> Project success is a topic that is frequently discussed and yet rarely agreed upon. The concept of project success has remained ambiguously defined. It is a concept which can mean so much to so many different people because of varying perceptions, and leads to disagreement about whether a project is successful or not.

The above showed that there was a distinction between project success and the success of the project management application (Baccarini, 1999, Wit, 1988). Unlike project success, project management success tends to be confined to the so-called triple constraint (PMI, 2004, Thomas and Fernandez, 2008, Pinto, 2007, Wit, 1988) or iron triangle (Atkinson, 1999) of project cost, time, and performance, the elements that define the very nature of a project (Pinto, 2007). This suggests that a project management team must ensure a project is consuming the allocated resources without risking going over budget, going behind schedule or below the client's minimum expectation of project performance. So, if the final product or service of the project is managed well from a project management perspective, it is not necessary to be perceived as successful in the strategic level context (Thomas and Fernandez, 2008, Baccarini, 1999, Jugdev and Muller, 2005, Lim and Mohamed, 1999, Munns and Bjeirmi, 1996). Many cases can provide examples of when a project team successfully delivered projects within the allocated resources, but the final products did not have the expected impact at the business level. These projects were managed well, although they were not perceived as successful. If an energy company, for example, has successfully delivered an oil refinery within or even below the allocated budget and before the expected delivery time, the project team would be applauded. However, if the refinery became operational at a time when the refined and processed oil was below the shareholders' acceptable expectations, then the project would be perceived as having less value even if it was delivered as planned. On the other hand, if the refinery was delivered beyond the allocated budget and with reported delays yet it operated at a time when the processed and refined oil price range was higher than shareholders' maximum expectations, the project would strategically be of much greater value (assuming losses incurred in delivering the project beyond the budget and time are quickly recovered). This also means that a project success, to the shareholders, for example, can fluctuate during the project's lifecycle. For example, BP's Macondo Well could have been perceived as a lucrative and successful project until the disastrous explosion of 20th April 2010, leaving behind it severe losses both financially and politically.

These examples present evidence of the independent relationship between project success and project management success. Project success is measured differently by a wide range of stakeholders and people, while the success of the project management application is confined to a project team's performance to meet the project iron triangle. Paradoxically, project success is the core concept of project management (Baccarini, 1999), but the project is surrounded and influenced by many factors that are beyond the direct control of the project management team (Munns and Bjeirmi, 1996), and in which tradeoffs between its main objectives are inevitable and common (Williams, 2002).

This research study was concerned with improving project management practice in the Saudi Arabian electricity supply industry. Therefore, much of the focus will be directed towards delivering projects on schedule and within the planned budget and scope. Moreover, most of the attention will be directed towards transforming project management into a strategic asset value for the investigated industry from a tactical asset value. Project management with strategic value is when a clear connection is made between how effectively and efficiently a project was delivered with the business value. Project management with tactical value, on the other hand, is when project success is limited to meeting project schedule, budget and planned scope, where the links to the broader business are missing (Jugdev and Muller, 2005). In other words, although the study was very concerned with meeting the challenging triple constraints in the targeted industry, the practice of project management would certainly have a strategic business value if the people involved were aware of their organisation's strategic goals. This would enable these people to articulate to the stakeholders how their projects could contribute to the achievement of these goals (Crowe, 2006).

3.6 Project Success Factors

As was mentioned previously, the main role of project management practitioners is to define, deliver and close projects successfully. Although perceptions of success vary from one stakeholder to another, the project management literature presents an interest in understanding and modelling the factors surrounding project success. For example, Lim and Mohamed (1999) define project success factors as "the set of circumstances, facts, or influences which contribute to the project outcome. These are the influential forces which facilitate or contribute to project success but do not form the basis of judgment" (Lim and Mohamed, 1999). However, the presence or absence of these factors does not guarantee the success or failure of a project, but they are good indicators of pre-conditions for its success or failure (Wit, 1988).

The Project Implementation Profile (PIP) devised by Pinto and Slevin has been widely used and has facilitated the examination of which aspects in a certain set of factors determine the success or failure of a project (Slevin and Pinto, 1986). They have made a valuable contribution in this specific area where the PIP demonstrated ten critical success factors and was used as a tool to diagnose a project's status. These ten factors were:

1) "Project mission: initial clarity of goals and general directions.
2) Top management support: willingness of top management to provide the necessary resources and authority/power for project success.
3) Project schedule/plans: a detailed specification of the individual action steps required for project implementation.

4) Client consultation: communication, consultation, and active listening to all impacted parties.
5) Personnel: recruitment, selection, and training of the necessary personnel for the project team.
6) Technical tasks: availability of the required technology and expertise to accomplish the specific technical actions steps.
7) Client acceptance: the act of “selling” the final project to its ultimate users.
8) Monitoring and feedback: timely provision of comprehensive control information at each phase in the implementation process.
9) Communication: the provision of an appropriate network and necessary data to all key factors in the project implementation.
10) Trouble-shooting: the ability to handle crises and deviations from plan”.

(Pinto and Slevin, 1988)

The PIP has facilitated the examination of which aspects of the above factors needed more attention when considering the success of a project (as perceived by the project management team) (Finch, 2003, Hyvari, 2006, Pinto and Prescott, 1988). The relative importance of these factors changed significantly over each project stage; these changes were in terms of project conceptualization, planning, execution, and termination (Pinto and Prescott, 1988). Finch (2003) applied the PIP on an information system project within a global company (Finch, 2003). Pinto and Slevin had previously addressed the absence of a few factors that were not considered in the PIP and could have played key roles in a project’s progress; this suggests the limitation of the PIP methodology. Finch (2003), however, emphasised the following limitations: excluding the competence and characteristics of a project manager; not addressing the political activity and cultural climate; not considering the external organisational and environmental factors; and not addressing the perception of how urgent the project was (Finch, 2003).

Hyvari (2006) has also employed the PIP to test whether dependencies between organisational context (size, type, experience) and critical success factors in project management exist. She found that the importance of project communication is related to company size (Hyvari, 2006). A positive correlation existed between an organisation's size and the importance of project communication. The larger the company was, the more important project communication appeared. She also used the PIP to analyse the most critical success factors along the project phases as was applied by (Pinto and Prescott, 1988). Communication ranked as the most critical success factor in the planning, execution and closing of project phases.

Belassi and Tukel (1996) developed a framework for determining critical success factors in projects. They grouped the success factors into the following categories: project-related factors (i.e. size, value, complexity, urgency); project manager and project team members background factors (i.e. competency, commitment); the organisation (i.e. top management support, project sponsor); and the external environment (i.e. political, technological). Addressing the external environment along with project and project team characteristics were their original contribution to the knowledge, they claimed (Belassi and Tukel, 1996). The framework was conceptually developed and empirically examined in several industries but was not applied in any further studies.

Anderson *et al.'s* (2006) framework identified project success factors within the direct control of project managers. The framework was empirically examined in four culturally different countries (the UK, France, China and Norway). The most important factors identified were: strong project commitment; early-stakeholder influence; stakeholder endorsement of project plans; and rich project communication (Anderson *et al*., 2006). The study also suggested that a well-structured and formal project approach will offer rich project communications channels and provide a learning project environment.

Clarke (1999) addressed how to practically use project success factors in an aerospace engineering context. After conducting a comprehensive investigation in the targeted organisation, she identified the following relevant critical success factors: focused and effective communication throughout the project; clear objective and scope; breaking the project into manageable work packages; using project plans as working documents. The main problems in the investigated company were then targeted by focusing on these key success factors to enhance the effectiveness of project management practice (Clarke, 1999). Compared to other work in this area, the main difference in Clarke's work was that her identified success factors were conceptualised through an understanding of the existing problems in a much more focused context. Similarly, Diallo and Thuillier (2004) identified the significance of the political environment in the African development projects. These projects were funded by an international development community which required high level political skills for the project manager to successfully deliver the projects (Diallo and Thuillier, 2004). Loring (2007), on the other hand, considered an example of the public being the main stakeholder in having planning permission for wind energy projects in the UK and Denmark. In this study, it was noted that projects with a high level of local community involvement during the conceptual phase were more likely to be publicly accepted. Public acceptance of these projects was an important factor for project permission, which indicated the urgent need to identify how to approach key stakeholders in a timely manner (Loring, 2007). Ignorance of such issues could have significant effects on project progress and success (Cleland, 1989).

The above studies reveal a genuine interest in identifying the factors surrounding project success. Much of the research has adopted broader definitions of project success. However, the traditional iron triangle constraint (time, budget and scope) seemed to prevail as the key project success criteria (Soderlund, 2004). But even when project success criteria were limited to meeting these three constraints, projects were still demonstrating poor records of successful completion. This could be rooted in a wide range of reasons. For example, Anderson *et al.* (2006) identified common project success factors in four different countries. However, applying the necessary steps to effectively make use of these identified success factors would differ not only from one country to another, but also from one organisation to another within the same country and industry (Bredillet *et al*., 2010). The dynamic nature of projects required the pursuit of in-depth investigations in project-driven organisations to conceptualise how success factors could be applied (Clarke, 1999). Clarke's success factors were suggested when she adopted a problem-driven approach rather than measuring an established set of success factors and determining the weakest links. Diallo and Thuiller (2004) also addressed the need for having project managers with high level political skills to be able to deliver development projects in Africa; without such a high skill level, both projects would have faced serious challenges (Diallo and Thuillier, 2004). In democratic countries such as the UK and Norway, public acceptance must be provided to secure wind energy project permission, for example, right from the conceptual phase. As a result, understanding how to tackle public concerns was perceived as a critical project success factor (Loring, 2007).

The examples above indicate that project success factors are either generic or specific (Thiry, 2005), where project professionals need to know what factors lead to consistently successful projects (generic factors) in addition to what factors are critical to success for an individual project (specific factors) (Cooke-Davies, 2002). This demonstrates that different projects could present different sets of project success factors (Dvir *et al*., 1998). Therefore, to maintain a sustainable project success in the Saudi Arabian electricity supply industry, a thorough understanding of what factors determine project success will be articulated through, as a necessary step, understanding what factors are indeed challenging the project success itself.

3.7 Project Management Maturity Models

Apart from identifying factors surrounding project success, there has been an increasing interest shown by organisations in reviewing their internal project management processes to make sense of why some projects succeed and others do not (Jugdev and Thomas, 2002). Although considered relatively new and none have achieved acceptance at a worldwide level yet, Project Management Maturity Models are well known for identifying project and organisational strengths and weaknesses, and for providing benchmarking information (Jugdev and Thomas, 2002). In fact, any newly introduced subject has great room for development, especially if it has been embedded within a fast developing discipline such as "project management". Project Management Maturity Models have already become part of documented practice in the APM and PMI Bodies of Knowledge (PMI, 2004, APM, 2006). Brookes and Clark (2010) have highlighted a number of disparities in the ways in which these were conceptualised, including their delineation of the "maturity" construct and the project management knowledge areas they covered (Table 3.1). This has consequently meant that the scope of each model is different from the others (Brookes and Clark, 2010).

Table 3.1: Knowledge Areas considered in established Project Management Maturity Models

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Source: (Brookes and Clark, 2010)

For example, Ibbs and Kwak (2000) devised a Project Management Maturity Model that assessed how developed the project management was in organisations on a relative scale of 1 (lowest) to 5 (highest) (Ibbs and Kwak, 2000, Kwak and Ibbs, 2002). In their model, they targeted organisations in different industries, including construction, to assess their project management maturity against the following eight knowledge areas and five project phases introduced in the PMBoK guide (Table 3.2):

Table 3.2: Project Management knowledge areas and project phases in Ibbs and Kwak's (2000) Project Management Maturity Model

Eight knowledge areas	Five project phases
Project scope management	Project initiating
Project time management	Project planning
Project cost management	Project executing
Project quality management	Project controlling
Project human resources management	Project closing
Project communication management	
Project risk management	
Project procurement management	

When compared to other industries, the construction industry had the highest score of 3.36. In general (i.e. projects across all investigated industries), results showed that the risk management and project execution phase were areas of low maturity. On the other hand, cost management and project-planning were areas of high maturity (Ibbs and Kwak, 2000). In other words, organisations showed well-established processes relevant to cost estimation during project planning, but processes relevant to identifying and responding to uncertainties during execution were not as mature. The study gave the participating organisations an indication as to which project knowledge areas and phases were of high or low maturity, leading to a competitive advantage if proper actions were taken. Jugdev and Thomas (2002), however, concluded that such maturity models were not able to provide a sustainable competitive advantage. This was reasoned in the fact that these models captured explicit, codified practice (know-what), but did not include the intangible assets of project management (know-how). These models were typically overly disciplinary and impractical since they focused on the work processes and ignored the human and organisational interactions. In a later development, Brookes and Clark (2010) conducted a comprehensive examination across a wider range of Project Management Maturity Models that showed consideration of these intangible assets as in both studies of Cooke-Davies and Arzymanow (2003) and Andersen and Jessen (2003) (Table 3.1). Yet, there was an apparent limitation in their extent of use impact on project performance. This indicates that although the Project Management Maturity Models is a wide subject, there is a great need to identify which of these models stimulate effective change in project management practice to improve project performance.

3.8 Project Owners, Consultants and Contractors

Having a diverse range of project characteristics compounded with the involvement of several organisational stakeholders increases the challenges facing the project implementation process. Several project stakeholders have different interests and influences on projects (Figure 3.1) (Mallak *et al*., 1991). However, this study's central concern was with the main project stakeholders who were involved with day-to-day project details. These were typically a project owner who recognises a need which can be satisfied by physical structure, a project consultant who is able to translate the owner's primary needs into basic drawings and schematics satisfying the main project requirements, and, finally, a project contractor who actually creates and realises the physical structure fulfilling both the owner's and consultant's requirements. The previously mentioned stakeholders represent, in simplest form, the three main phases of the construction project process, namely, project conception, project design and project construction (Chan and Kumaraswamy, 1997). It would be ideal if a project could result in an overall win-win situation for all these three stakeholders, and this should always be a target (Lim and Mohamed, 2000). In reality, the dynamics between these organisations, which also may be involved in other projects with each having unique business circumstances, makes it very difficult to have project progress without challenges. In fact, project conflict between these three stakeholders has been perceived as a normal practice in projects (Al-Sedairy, 1994). The concern, however, is when conflict can have a negative impact on meeting the project constraints of scope, budget and time.

3.9 Construction Project Delay – Central Research Challenge

The scale and breadth of project management challenges and problems are enormous, and they are definitely far greater when addressed in a single study. Moving from the divergent view of the challenges facing construction projects into a more convergent one, the focus of this study was centred on achieving the following elements that define a project: meeting a project's scope, its delivery schedule and the allocated budget to finance its construction activities. These elements are highly dependent on each other. For example, allocating insufficient funds for a project, can either have an effect on the project time delivery (until enforcement provision is secured) or require necessary adjustment to the project scope (downgrading the scope lowers the project's total cost). Also, any change in project scope during project construction and execution will have an impact on the project's total cost (additional working hours for redoing the activity is most probably required) in addition to the time extension needed to do the job (assuming the activity is within the critical path where the progress of other activities is affected). Since this study is more concerned with the use of projects to bridge the growing gap between electricity supply and demand in Saudi Arabia, then, obviously, time is of the essence since electricity projects are urgently required to be delivered within the decided time schedule to reduce any further widening of the gap. Substantial amounts of money are being invested in the industry, which has led to the authorisation of hundreds of projects seen as the most urgent means of addressing the growing challenges of meeting the accelerating electricity demand requirements. Therefore, it is of great concern that the delivery and operation of these authorised projects is achieved as soon as possible and without any delay. This is especially true due to the fact that the Saudi government announced its largest expenditure budget in its history at the end of 2009, authorising many more public projects requiring proper, basic infrastructure including electricity (Table 1.3).

From this foundation, and knowing that the three project elements of scope, time and budget are dependent on each other; this study sought to identify the project implementation challenges through focusing on critical factors delaying projects in the investigated industry. In other words, project delay factors in the Saudi Arabian electricity supply industry are used to model the project implementation challenges since project delay has already become an accepted phenomenon in the project industry. It is argued that a holistic outlook and a comprehensive understanding of project delay factors will result in authoritative recommendations that seek to reduce the unwanted effects of the project implementation challenges.

A diverse range of project characteristics and involvement with various stakeholders (project owner, contractor, consultant, designers, suppliers etc.) who each come with different perceptions, objectives and hence priorities, and who each adopt different and probably inadequate practices in terms of project management tools and techniques, creates a fertile ground for construction project delays. Therefore, many studies have strived to pinpoint the most important project delay factors with the aim of controlling them and minimizing their adverse effects on project stakeholders (Faridi and El-Sayegh, 2006, Al-Kharashi and Skitmore, 2009, Aibinu and Jagboro, 2002, Alaghbari et al., 2007, Alkass et al., 1996, Al-Khalil and Al-Ghafly, 1999b, Al-Khalil and Al-Ghafly, 1999a, Al-Momani, 2000, Arditi et al., 1985, Assaf and Al-Hejji, 2006, Chan and Kumaraswamy, 1997, Kaming et al., 1997, Kumaraswamy and Chan, 1998, Lim and Mohamed, 2000, Mezher and Tawil, 1998, Odeh and Battaineh, 2002, Ogunlana and Promkuntong, 1996, Sambasivan and Soon, 2007, Stumpf, 2000, Sweis et al., 2008, Shehu and Akintoye, 2010, Assaf et al., 1995, Koushki et al., 2005). Arguably, the vast majority of project delays have occurred during the construction phase (Chan and Kumaraswamy, 1997), where all inadequacies in the preceding phases have become apparent (Lim and Mohamed, 2000). The following studies clearly demonstrate common project delay factors.

3.10 Project Delay Studies in Developing Countries – A Construction Industry Context

Many studies have been conducted in different parts of the world to identify construction project delay factors. Results have shown that these project delay factors (PDFs) are usually interconnected (Alkass *et al*., 1996), complicating how the causes of the delays should be addressed. Examples of studies conducted in several countries are summarised in Tables 3.3 – 3.5 below. They confirm that project delay was a common feature in construction projects. The traditional approach in these studies was to identify several PDFs either empirically, where data were collected from project practitioners, or conceptually, where they were based on relevant research conclusions, or both. The PDFs were expected to have different attributes in which, for example, some were related to financial issues and others were related to material and manpower issues.

Stumpf (2000) defines a project delay as “an act or event that extends the time required to perform tasks under a contract. Delays usually show up as additional days of work or as the delayed start of an activity” (Stumpf, 2000). Therefore, for the purpose of this study, a PDF was considered as any circumstance, force, or constraint that contributed to project delay. To further understand PDF forms, the following tables present summaries of construction project delay factor studies conducted in different countries:

Table 3.3: Literature Review summary of key project delay factors identified in various construction industries in Asia

Researchers	Country	Project Type	Time Overrun	Cost Overrun	Key Stakeholders	Key Delay Factors	Delay factor importance accoding to:	Additional notes
Sambasivan	Malaysia	Construction	NA	NA	Public and Private	Inadequate client's finance and payments for completed	All key Stakeholders considered	
and Soon		Projects			Owners,	works		
(2007)					Contractors	Contractor's improper planning	All key Stakeholders considered	
					and Consultants	Inadequate Contractor's experience	All key Stakeholders considered	
						Contractor's poor site management	All key Stakeholders considered	
Alaghbari	Malaysia	Construction	NA	NA	Public and Private	Financial factor was the most influencing delaying projects	All key Stakeholders considered	
et al.		Projects			Owners,	Coordination problems between involved parties	All key Stakeholders considered	
(2007)					Contractors	Material-related problems	All key Stakeholders considered	
					and Consultants			
Long et al.	Vietnam	Large Construction	NA	NA	Owners,	Incompetent designer/contractor	All key Stakeholders considered	
(2004)		Projects			Contractors	Poor estimation and change management	All key Stakeholders considered	
					and Consultants	Social and technological issues (obsolete technology and	All key Stakeholders considered	
						burereaucracy)		
						Site related issues	All key Stakeholders considered	
						Improper techniques/tools	All key Stakeholders considered	
Kaming	Indonesia	Construction	55% of PMs	52% of PMs	Project managers	Design changes	Overall Project Managers'	
et al.		Projects (hospitals,	completed	completed		Poor labor productivity	evaluation	
(1997)		residential, offices,	more than 90%	70-90% of		Inadequate planning and resource shortages		
		shopping and	of projects	projects				
		a hotel buildings)	on time	within budget				
Chan and	Hong Kong	Construction	NA	NA	Owners,	Poor site management and supervision	All key Stakeholders considered	
Kumarswamy		Projects			Contractors	Unforeseen ground conditions	All key Stakeholders considered	
(1997)					and Consultants	Slow decision making by project teams involved	All key Stakeholders considered	
						Client initiated variations (change orders)	All key Stakeholders considered	
						Necessary variations of works (change orders)	All key Stakeholders considered	
Ogunlana	Thailand	Construction	Maximum	NA	Owners,	Shortages of necessary resources	Overall Project Managers'	Survey of 12
et al.		Projects (hospitals,	delay was 50%		Contractors	Problems caused by clients and consultants	evaluation	projects
(1996)		residential, offices,	of original		and Consultants	Contractor incompetence problems		
		academic buildings	duration and					
		and a hotel)	minimum was					
			5%					

Table 3.4: Literature Review summary of key project delay factors identified in various construction industries in the Middle East (except for Saudi Arabia)

Researchers	Country	Project Type	Time Overrun	Cost Overrun	Key Stakeholders	Key Delay Factors	Delay factor importance accoding to:	Additional notes
Sweis et al. (2008)	Jordan	Construction Projects	NA	NA	Owners, Contractors and Consultants	Financial difficulties faced by the contractor	All key Stakeholders	
						Too many change orders from owner	Contractors and Consultants	
						Contractor with poor project planning and scheduling	Owners and Consultants	
						Incompetent Contractor technical staff	Owners	
						Shortage of manpower (skilled, semi-skiled and unskilled)	Contractors	
Faridi and El-Sayegh (2006)	United Arab of Emirates (UAE)	Construction Projects	50% of projects encountered delays	NA	Contractors and Consultants	Preparation and approval of drawings	All key Stakeholders considered	Project owner number of participants was neglegible
						Inadequate early planning of project	All key Stakeholders considered	
						Slow decision making by the owner	All key Stakeholders considered	
						Shortage of manpower (skilled, semi-skiled and unskilled)	All key Stakeholders considered	
Koushki et al. (2005)	Kuwait	Private Residential Construction Projects	55% of projects experiened change orders were delayed	NA	Owners and Developers	Change orders due to the insufficient time and money allocated in their desig phases	All key Stakeholders considered	
						Financial constraints	All key Stakeholders considered	
						Owner's lack of experience	All key Stakeholders considered	
Odeh and Battaineh (2002)	Jordan	Public and private Construction including buildings, roads, water and sewage projects	NA	NA	Contractors and Consultants	Finance and payments of completed works	All key Stakeholders considered	Public owners did not participate
						Owner interference	All key Stakeholders considered	
						Inadequate contractor experience	All key Stakeholders considered	Lowest bidder selection basis
Mezher and Tawil (1998)	Lebanon	Construction Projects	NA	NA	Public owners, Contractors and Consultants	Financial aspects including progress payments by the owner and financing difficulties by Contractors	All key Stakeholders considered	
						Contractual relationship problems including uncooperative owners, slow-decision making and poor communication	All key Stakeholders considered	
						Project Management aspects including poor estimation and planning and lack of personel training	All key Stakeholders considered	
Arditi et al. (1986)	Turkey	Public Construction Projects	NA	NA	Public owners and Contractors	Contractors and public agencies experienced financial difficulties	All key Stakeholders considered	
						Shortage of many resources including manpower and materials	All key Stakeholders considered	
						Both Public agencies and Contracting companies suffered from slow-decision mechanism and ill-defined duties	All key Stakeholders considered	
						Delays relevant to inadequate design work, frequent change orders and large quantities of extra work	All key Stakeholders considered	

Table 3.5: Literature Review summary of key project delay factors identified in various construction industries in Saudi Arabia

Researchers	Country	Project Type	Time Overrun	Cost Overrun	Key Stakeholders	Key Delay Factors	Delay factor importance accoding to:	Additional notes
AlKharashi	Saudi Arabia	Public Construction	NA	NA	Public owner,	Lack of finance to complete the work by the owner	All key Stakeholders	Owner-related
and					Contractors	Non-payment of contractor claim	Owners and Contractors	factors were
Skitmore					and Consultants	Delay in progress payments by owners	Owners and Consultants	with the greatest
(2009)						Late revision and approval of design documents	Contractors and Consultants	effect delay
						Delay in approving sample materials	Contractors and Consultants	causes
						Slow decision making by the owner	Owner	
						Uncooperative owner with contractors complicating	Owner	Lowest bidder
						contract administration		selection basis
						Suspension of work by owner	Contractor	
						Delay to furnish and deliver the site to the contractor	Consultant	
Assaf and	Saudi Arabia	Large Construction	NA	NA	Public owner,	Delay in progress payments by owners	Contractors and Consultants	Lowest bidder
Al-Hejji		Projects			Contractors	Difficulties in financing projects by contractors	Contractors and Consultants	selection basis
(2006)					and Consultants	Shortage and unproductive labours	Owners and Consultants	
						Change orders by owner during construction	All key Stakeholders considered	
Al-Khalil	Saudi Arabia	Public Construction	Overall	NA	Public owner	Cash flow problem faced by contractors	All key Stakeholders	Lowest bidder
and			average		(Water and	Delay in progress payments by owners	Contractors	selection basis
Al-Ghafly			extent of		Sewage Authority	Difficulties in financing projects by contractors	Owners and Consultants	
(1999)			delay was 39%		in 10 different	Government tendering system reuirement of selecting	All key Stakeholders	
			of original		regions),	the lowest bidder		
			contract		Contractors	Difficulties in obtaining work permits	Owners and Contractors	
			duration		and Consultants			

3.10.1 Hong Kong

Hong Kong experienced a boom period in its construction industry in the early 1990s. Therefore, it was deemed necessary to determine and identify the significant factors causing delay in Hong Kong construction projects in order to propose practical strategies which suitably addressed these factors (Chan and Kumaraswamy, 1997, Kumaraswamy and Chan, 1998). The studies were confined to construction projects completed between 1990 and 1993. 83 different delay causes were considered, and these were grouped into categories relevant to the following: a project's main stakeholders (i.e. project owner, contractor and consultant), a project's resources (labour, material and equipment), a project's nature and characteristics (type and size) and external factors influencing the project (such as weather concerns and restrictions). The overall key PDFs relating to the main stakeholders involved were poor site management and supervision, unforeseen ground conditions, low speed of decision making involving all project teams, client initiated variations, and necessary variations in the work.

Project site management and supervision showed concerns relevant to project execution practice. These activities required project team members with a certain set of skills and who were equipped with adequate project management tools and techniques to keep track of progress and, hence, were able to control the project and prevent unwanted slippage. This was evident when project owners and consultants ranked the contractor-related delay causes group highest, as the indicated contractors were lacking experience to adequately plan for the activities and monitor the site. This inevitably caused project cost overruns to levels which probably sparked disputes. On the other hand, slow decision making by project owners and consultants in addition to client initiated work variations contributed to a contractors' project management performance. This was evident when contractors ranked the inadequate design experience of consultants as the main cause of project delay in Hong Kong construction projects.

3.10.2 Indonesia

Kaming *et al*. (1997) surveyed 31 high-rise projects in Indonesia and identified eleven different PDFs. The predominant PDFs in these projects were mainly related to human resource skills since many design changes and poor labour productivity were noticed. Other key PDFs identified were also relevant to inadequate planning and material and equipment resource shortages (Kaming *et al*., 1997).

3.10.3 Jordan

Jordan shares a southern border with Saudi Arabia and an eastern border with Iraq. Several studies were conducted to identify PDFs in the Jordanian construction industry (Al-Momani, 2000, Odeh and Battaineh, 2002, Sweis et al., 2008). There was a general agreement that PDFs caused by financial issues were the most frequent. These PDFs were mainly caused by a weak Jordanian economic climate which also had an impact on material resource availability. While public project owners identified PDFs as stemming from contractors having inadequate planning and scheduling abilities (Sweis *et al*., 2008), thus demonstrating a lack of experience in conducting these projects (Odeh and Battaineh, 2002), contractors considered the initiation of too many project change orders (Sweis *et al*., 2008), the lack of project ownership (Al-

Momani, 2000), and inappropriate interference from project owners as the most important PDFs in the Jordanian construction industry.

3.10.4 Kuwait

The construction of private residential projects in Kuwait noticeably accelerated after the Iraqi invasion of 1990-1991. After this destructive war, the construction of private residences boomed as a result of Kuwait's general wealth. These projects were smaller in size (in terms of cost) and, therefore, they were less complex than those investigated in the literature. Yet, some of these projects were also delayed, causing cost overruns. A study by Koushki *et al*. (2005) used personal interviews to survey 450 private residential project owners and developers in order to determine the causes of time and cost overruns. It was proven that private residence owners who allocated more time and financial resources to the planning and design phases issued less change orders (identified as a delay cause). The selection of more experienced contractors, and the hiring of supervising engineers to independently monitor the progress of work and to ensure the delivery of required materials, were identified as contributors to better project progress with less time delay and cost overrun during the construction period (Koushki et al., 2005).

3.10.5 Lebanon

Lebanon experienced a civil war between 1975 and 1990 which resulted in severe damage to buildings, with many being completely destroyed. Since the reconstruction process started in 1992, it was observed that many construction projects have not been delivered on time, putting at risk an opportunity for the national economy to gain confidence. Therefore, it was necessary to identify the most important PDFs in the Lebanese construction industry projects in order to take appropriate action (Mezher and Tawil, 1998). Research focused on projects that cost over US $10 million and showed a strong agreement between the three sets of respondents (project owners, contractors and consultants) as to what constituted significant PDFs. Financial aspects, including delayed progress payments by public owners to contractors and financing difficulties by contractors, were the most important PDFs in the investigated industry. Poor planning and estimation coupled with contractors' lack of skilled project staff were also identified in the study. Contractors also suffered from having contractual relationship problems with project owners who were uncooperative, slow with their decision making and poor communicators.

3.10.6 Malaysia

The role of the construction industry has increasingly grown in Malaysia as it progresses towards being a developed industrial society. Therefore, many studies have strived to address the most important PDFs in an effort to draw roadmaps for better project delivery performance in the Malaysian construction industry (Alaghbari et al., 2007, Lim and Mohamed, 2000, Sambasivan and Soon, 2007). Owners' inadequate financing of projects and the delay of progress payments to contractors were found to be the most significant PDFs (Alaghbari et al., 2007, Sambasivan and Soon, 2007). Contractors' lack of experience was reflected in their poor planning abilities, poor site management during project execution (Sambasivan and Soon, 2007) and coordination problems with relevant stakeholders (Alaghbari *et al*., 2007). Lim and Mohamed (2000) note that a "Projects were completed anyway" attitude prevailed in the Malaysian power transmission projects, which indicated there were no initiatives to properly review project lessons after projects were delivered. Such loss of captured knowledge prevented contractors from being provided with proper experience that could have improved their planning and site management qualities.

3.10.7 Thailand

The Thai construction industry experienced an unexpected boom between 1988 and 1992. The industry, however, was not adequately prepared for such growth since project management discipline was struggling to mature. Consequently, understanding the most significant PDFs was used as a means to improve project management practice. It was noted that resource supply problems were the most acute PDFs, especially shortages in the cement supply which caused severe project delays. Construction project owners frequently demanded changes that created coordination problems which affected project activity sequences and, as a consequence, caused disruption and additional project time extensions. Contractors also lacked personnel with adequate technical and managerial skills (Ogunlana and Promkuntong, 1996).

3.10.8 Turkey

One of the earliest research studies concerned with identifying reasons for project delay in public construction projects in a developing country was conducted in Turkey (Arditi *et al*., 1985). However, it presents a very similar set of significant PDFs when compared to more recent PDF studies. At the time of the study, financial difficulties faced by both public agencies (project owners) and project contractors were highly considered in Turkey. Shortages of essential resources such as qualified manpower, materials and equipment were among the significant PDFs. These were reflected in having slow decision-making mechanisms and ill-defined duties and responsibilities in both organisations (public agencies and contractors). Moreover, frequent change orders for inadequately designed work and large quantities of extra work were common in the investigated projects.

3.10.9 United Arab Emirates (UAE)

The United Arab Emirates has gained world recognition with its construction growth and activity. Great emphasis has always been placed on construction projects being completed within the specified delivery time. However, in one study around half of the UAE construction projects were reported as being delayed (Faridi and El-Sayegh, 2006). The study only considered contractors and consultants, while the number of participating project owners was insignificant. Shortages of productive and skilled manpower were reflected in inadequate early planning, and this was considered to be among the most important PDFs. Late design approval by consultants and slow decision making by owners also represented very important PDFs. Financing problems, although considered significant, were limited to contractors during construction. Although project owners were not considered in the survey, late progress payments for completed work by project owners were not considered to be as significant as they were in other studies.

3.10.10 Saudi Arabia

The Saudi Arabian construction industry has been the largest recipient of Saudi government petrodollars spending. For example, the expenditure in its development plans in the period 1970-1985 ranged between 30-50% of government spending (Assaf *et al.*, 1995). In the latter part of the decade, government expenditure on basic infrastructure declined sharply in response to the severe decline in oil revenues between the late 1980s and early 1990s. However, when oil prices increased significantly between 2003 and 2008, the government initiated huge plans to continue building the national infrastructure, including the building of new cities from scratch (SAGIA, 2010). At present, while the world is still facing the worst global economic downturn for many decades, and most countries around the world are adopting huge cuts in their spending levels, the Saudi government is among those who have maximised their spending as a stimulus package to boost their internal national economies. This was in an effort to minimise the adverse effects of the weak global economy by injecting substantial financial resources into local private businesses (Table 1.3).

It is worth noting that Saudi Arabia has continuously faced criticism of its public projects. Extensive research by Niblock and Malik (2007) revealed the situation in Saudi Arabia towards the latter part of the decade:

> Many interviewees (Saudi businessmen from different backgrounds) noted that when the government was building the infrastructure they missed out some key elements, and that the infrastructure created was now a substantial burden on the economy. Massive spending was needed both to maintain the existing infrastructure and to build new infrastructure to keep up with the demands of the economy.

In the years following the tragic events of 9/11, the Saudi Arabian media have been open to active criticism of public services and projects. In addition, the local media has recently developed into a project stakeholder where newspapers track official announcements of figures and promises and compare these with their relevant project progress.

Apart from the quality level of the delivered projects, various studies have focused on identifying PDFs in the Saudi construction industry. The wealth of the Saudi government was thought to place project financial factors among the least of the delaying factors, especially in public projects. Surprisingly, this was not the case since financial PDFs have been considered as the most significant ones across all relevant studies (Al-Khalil and Al-Ghafly, 1999b, Al-Khalil and Al-Ghafly, 1999a, Al-Kharashi and Skitmore, 2009, Assaf and Al-Hejji, 2006, Assaf et al., 1995). In studies conducted between 1995 and 2009, lack of financial resources to complete project work, and delay in progress payments by public entities to contractors, were observed as being very common in Saudi public projects. This was strongly related to the extreme bureaucratic measures that Ministries and public agencies require for project budgets to be approved. The procedure for allocating most of the public project budgets is highly centralised and is controlled by the Ministry of Finance. Approving inadequate project budgets (i.e. the lowest bidder offer is higher than the approved and allocated budget) has become a phenomenon in Saudi public projects. This, of course, lengthens the procedure where re-enforcement provision is required. Normally, such re-enforcement could take up to several months and, in some cases, a few years.

Contractor payments for some public projects are also required to be processed through the Ministry of Finance. This has serious consequences for many contracting businesses, with the most serious being the apparent reluctance of contractors to bid for some public projects. Although PDF studies in Saudi Arabia were conducted between 1995 and 2009 (Al-Khalil and Al-Ghafly, 1999b, Al-Khalil and Al-Ghafly, 1999a, Al-Kharashi and Skitmore, 2009, Assaf and Al-Hejji, 2006, Assaf et al., 1995), PDFs relevant to financial factors were still persistent, demonstrating resistance to change.

Contractors, especially of small and medium size, also suffer in the financing of public projects. The banking industry has been facing criticism since banks are focusing on the provision of financial facilities to corporate (large) size contractors (contractor size definitions differ from one bank to another). Although government contracts are considered safe investments for banks, where the provision of financial facilities to contractors will have high returns, these banks are complaining of a lack of comprehensive and well-developed legislation that protects their interests (BMI, 2010a).

Shortages of manpower and unproductive manpower in projects have also been considered common in Saudi public projects (Assaf and Al-Hejji, 2006, Assaf et al., 1995). Many compounding reasons surround this particular PDF. The Saudi Ministry of Labour announced a reduction in the unemployment rate from 11.2% in 2007 to 9.8% in 2008 (MOL, 2010), while other sources (including the World Bank) have criticised the figure as it does not consider unemployed females; with the inclusion of the female unemployed figures, the estimate could have reached up to 25% (CIA, 2010). In general, the business sector in Saudi Arabia has criticised the education system which has failed to provide graduates with proper and useful skills (Niblock and Malik, 2007). On the other hand, the Ministry of Labour, which regulates the issuing of work permits for the non-Saudi workforce, has criticised the business sector's tendency to employ non-local graduates. A non-local, averagely skilled workforce is, generally, perceived to be more productive with less cost involved. Therefore, authorising substantial projects in such a restrictive and difficult business climate will definitely be affected by manpower shortages and an unproductive workforce, contributing to poor project performance.

Public projects in Saudi Arabia are almost always awarded to the lowest bidder in an open competitive climate. The selection process of the 'government tendering system requirement of selecting the lowest bidder' was considered among the most important PDFs as indicated by all main stakeholders of project public owners, contractors and consultants (Al-Khalil and Al-Ghafly, 1999b). The main criticism was centred on the lack of having an established pre-qualification system where only capable contractors were selected. This allowed inexperienced and incompetent contractors to execute public projects.

The following content analysis is based on references available in the literature and, although it may appear to be a random selection of developing countries, these studies have actually been referenced frequently. Moreover, the literature review has focused solely on developing countries since Saudi Arabia is also identified as belonging to this category.

3.11 Discussion of Key Project Delay Factors

Tables 3.3 – 3.5 have confirmed that project delay occurred in all construction industries with varying degrees. The factors which contribute to project delay are complex and highly interconnected with each other (Sweis *et al*., 2008). However, researchers have strived to simplify the complexity of these delay causes by reducing their structures to manageable factors to enable further analyses. These studies, although conducted in different parts of the world, managed to identify an emergent pattern of project problems that impeded project progress. Project delay factors were caused by all stakeholders (project owners, contractors, consultants) and, if not by these, then by external forces. The contribution level of each towards project delay depended on a countless number of factors, especially those relevant to project resources. The following presents the frequent project delay factors identified in Tables 3.3 - 3.5 with thorough discussions:

- **Resource constraints (financial, human, materials and equipment)**

The most problematic project delay factors impeding project progress were those relevant to financial aspects, such as owners' delayed payments to contractors for completed work; as a result of such a delay, contractors faced difficulties in financing their awarded projects during construction (Sweis et al., 2008, Sambasivan and Soon, 2007, Kaming et al., 1997, Assaf and Al-Hejji, 2006, Arditi et al., 1985, Al-Khalil and Al-Ghafly, 1999b, Mezher and Tawil, 1998, Odeh and Battaineh, 2002, Alaghbari et al., 2007, Faridi and El-Sayegh, 2006). Another important problematic area of project resource was the manpower involved in these projects, as they were either perceived as unproductive with low skills (Assaf and Al-Hejji, 2006, Kaming et al., 1997) or as being unavailable, whether skilled or otherwise. This presented pressures on contractors, especially these who were awarded projects based on being the lowest bidders (Al-Khalil and Al-Ghafly, 1999b, Odeh and Battaineh, 2002).(Faridi and El-Sayegh, 2006, Sweis et al., 2008). This particular problem has most probably caused the contractors' project planning and scheduling ineffectiveness, and this was also identified as one of the major factors contributing to project delay (Chan and Kumaraswamy, 1997, Kaming et al., 1997, Mezher and Tawil, 1998, Sambasivan and

Soon, 2007, Sweis et al., 2008). Project planning and scheduling were identified as key processes since these specified sets of decisions are concerned with how project resources (financial, manpower, material and equipment etc.) are managed during project execution (Zwikael and Globerson, 2006). However, the studies showed that contractors were either not experienced enough to formulate sound planning (Chan and Kumaraswamy, 1997, Odeh and Battaineh, 2002, Sambasivan and Soon, 2007) or were interrupted by uncooperative project owners (Al-Kharashi and Skitmore, 2009, Mezher and Tawil, 1998) or slow project consultants who delayed necessary drawings or design approvals (Faridi and El-Sayegh, 2006).

All the above contributed to poor site management (Chan and Kumaraswamy, 1997, Sambasivan and Soon, 2007) which led to adverse contractual relationships between the three stakeholders (project owner, contractor and consultants), and this became acute when poor communication between the three accumulated (Mezher and Tawil, 1998). Therefore, both timely decision making by the project owner (Arditi et al., 1985, Faridi and El-Sayegh, 2006, Mezher and Tawil, 1998) and adequate early planning conducted by the contractor during construction (Chan and Kumaraswamy, 1997, Kaming et al., 1997, Sweis et al., 2008, Koushki et al., 2005) were crucial for project progress. These, however, were not easily achieved, especially in public projects where slow decision-making mechanisms (Faridi and El-Sayegh, 2006, Mezher and Tawil, 1998) and ill-defined project duties were common (Arditi *et al*., 1985); consequently, these caused coordination problems (Alaghbari *et al*., 2007) with internal stakeholders, where project ownership was vague (Al-Kharashi and Skitmore, 2009), and with external stakeholders, such as government authorities, which delayed the issuance of necessary project work permits (Al-Khalil and Al-Ghafly, 1999b).

- **Key project stakeholders' contractual commitments**

Strong project commitment by the project owner was identified as one of the most important factors for project success (Anderson *et al*., 2006). However the resource-relevant project delay factors discussed above increased resource management pressures on the key stakeholders, especially contractors who were awarded projects based on being the lowest bidders (Al-Khalil and Al-Ghafly, 1999b, Odeh and Battaineh, 2002). Most of the PDF studies confirmed the persistent delay in the progress payments made by the owners to the Contractors (Al-Kharashi and Skitmore, 2009, Arditi et al., 1985, Assaf and Al-Hejji, 2006, Odeh and Battaineh, 2002). This led to significant delays and prolonged disputes between Project Owners and Contractors when their payments were due. This could be resulted from a slow decision-making process in addition to the rigid requirements (Faridi and El-Sayegh, 2006, Mezher and Tawil, 1998, Arditi et al., 1985, Al-Kharashi and Skitmore, 2009).

The delay in the settlement of Contractor claims by project Owners was also common in the PDF studies (Zaneldin, 2006, Al-Kharashi and Skitmore, 2009, Faridi and El-Sayegh, 2006). Rejecting claims, especially the justifiable ones, led to Contractors perceiving project owners to be uncooperative, which complicated the contract administration (Al-Kharashi and Skitmore, 2009, Mezher and Tawil, 1998, Odeh and Battaineh, 2002). Suspension of project works by project Owners was also a serious factor contributing to project delay (Al-Kharashi and Skitmore, 2009, Chan and Kumaraswamy, 1997). The literature also showed the importance of securing public acceptance at the project planning stage, as detailed in Loring's study (Loring, 2007).

Project Owners were also delaying the delivery of the project site to the awarded Contractors (Al-Kharashi and Skitmore, 2009, Chan and Kumaraswamy, 1997). Change orders were also very serious and common PDFs in several construction industries (Arditi et al., 1985, Assaf and Al-Hejji, 2006, Chan and Kumaraswamy, 1997, Sweis et al., 2008, Koushki et al., 2005). The above indicated that maintaining the key project stakeholders' contractual commitments was of great concerns in most projects.

- **Lack of essential information and effective communication**

Contracts were usually of a developing nature. Therefore, not all project deliverables were specified. This serious flaw motivated both the Project Owners and Contractors to interpret the contract differently based on their interests which to placing change orders for additional deliverables. This was besides the noticeable lack of required information with regards to the technical limitations of the project site. Information availability was proven to be a serious problem in the reviewed studies. Contractors needed reliable information concerned with the project in a timely manner. But the information provided to the Contractor was, in many cases, inaccurate. For example, the site conditions differed from those described in the bidding packages (Arditi et al., 1985, Assaf and Al-Hejji, 2006, Chan and Kumaraswamy, 1997, Kaming et al., 1997, Sweis et al., 2008, Koushki et al., 2005). Bidding package arrangement is the most critical stage in projects (Ling and Poh, 2008) and therefore it was crucial to provide accurate information in this stage.

Maintaining effective communication and coordination with the relevant project stakeholders is an essential means for minimising project uncertainties (Jha and Iyer, 2007, Bentley and Rafferty, 1992). However the PDF studies proved this was an apparent and persisting challenge (Alaghbari et al., 2007, Arditi et al., 1985, Mezher and Tawil, 1998, Clarke, 1999, Pinto, 1990). Project communication represented the generation, collection, distribution and retrieval of project information (PMI, 2004), and project coordination indicated the harmonizing and integrating of project activities or requirements between the project parties (Jha and Iyer, 2006). However the lack of maintain effective communication between these parties led to difficulties during project construction. This could be reasoned to the fact that most of the Project Owners considered were public entities and that had rigid and highly centralised organisational structure.

3.12 Knowledge Gaps and Research Contributions

All project delay issues mentioned above varied from one industry to another. Significant project delay factors identified in an industry could be of less significance in another. In fact, the perception of the significance of project delay factors has, in some cases, varied within the same project industry. For instance, project owners, in some of these cases, were critical of their contractors' level of experience while contractors were complaining about, for example, project owners' contractual commitment. However, the conclusion was that project delays did exist and their effect must be minimised as much as possible. These delay factors occurred although project management was an established discipline with mature and specific steps, procedures and practices to manage and perform a project (Crowe, 2006). However, besides the unique nature of projects, the fact these projects were performed in different contexts suggests that the dynamic nature of a project continuously presents new challenges for project management researchers to address. This project will, therefore, explore the delay factors which represent and form the key challenges to project implementation in the Saudi Arabian electricity supply industry.

Since this study is more concerned with the use of projects to bridge the growing gap between electricity supply and demand in Saudi Arabia, then, obviously, time is of the essence since electricity projects are urgently required to be delivered within the decided time schedule to reduce any further widening of the gap. Substantial amounts of money are being invested in the industry, which has led to the authorisation of hundreds of projects seen as the most urgent means of addressing the growing challenges of meeting the accelerating electricity demand requirements. Therefore, it is of great concern that the delivery and operation of these authorised projects is achieved as soon as possible and without any delay. This is especially true due to the fact that the Saudi government announced its largest expenditure budget in its history at the end of 2010, authorising many more public projects requiring proper, basic infrastructure including electricity. Unfortunately, there is no available source of information or direct quotes on the extent to which projects are delayed in Saudi Arabia. However, a recent study (Alhilali, 2011) revealed that 65% of public projects in Saudi Arabia are being managed without established project schedules. The remaining 35% of public projects are being managed with project schedules; however, this fact does not indicate that these projects are progressing according to plan.

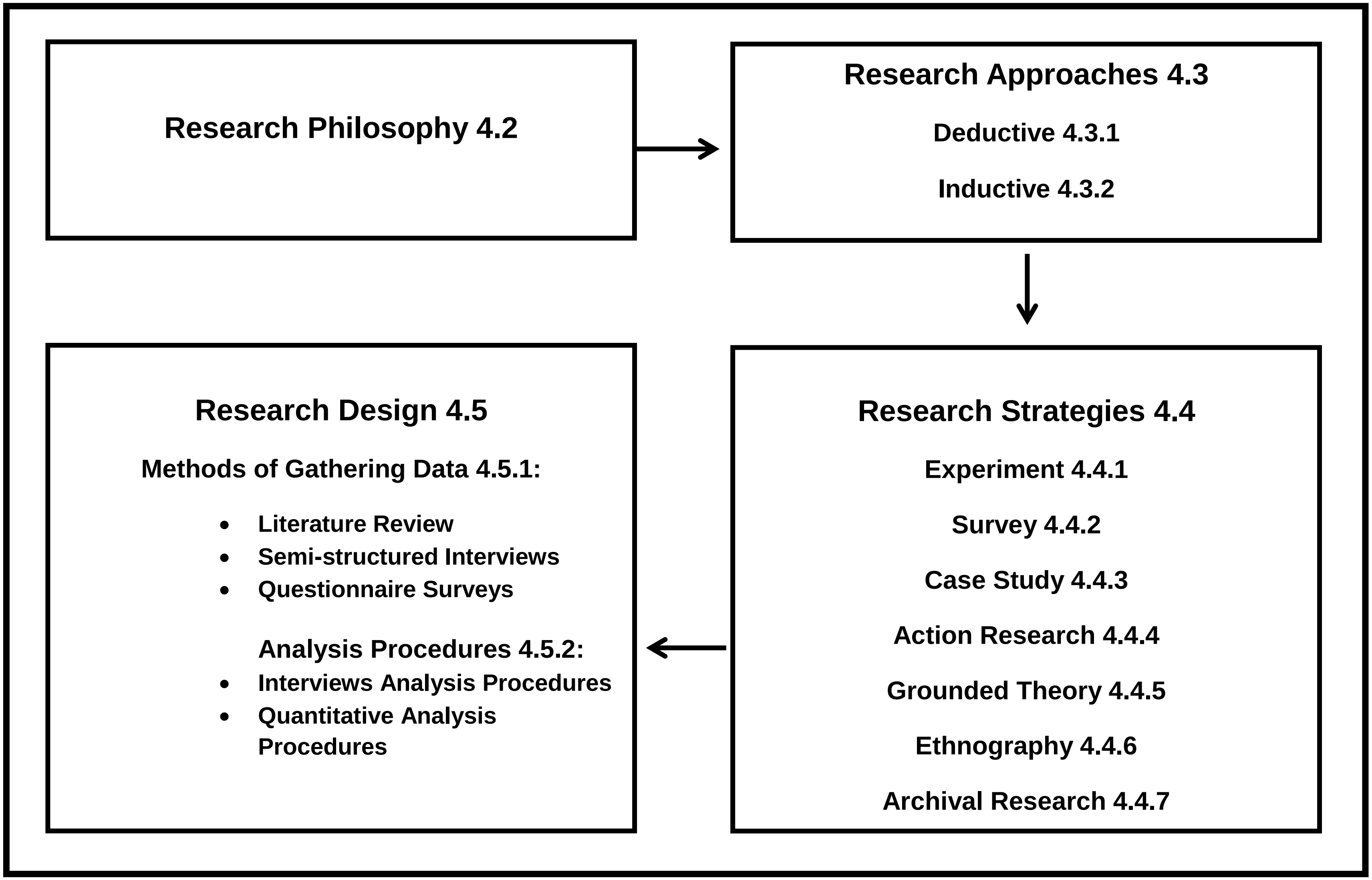
From this foundation, and given the political visibility of the Saudi Arabian power supply industry, this study sought to identify the project implementation challenges. This area has not been thoroughly addressed before. In fact, project delay has already become an accepted phenomenon in the investigated industry and, therefore, this research will investigate which of these project delay factors are of greater concern. It is argued that a holistic outlook and a comprehensive understanding of project delay factors will result in authoritative recommendations that seek to reduce the unwanted effects of the project implementation challenges.

4. Research Methodology

4.1 Introduction

This chapter aims to describe the methodologies and methods adopted to answer the research questions and meet the study's objectives. After describing the adopted research philosophy, which states how this study views the world, a review of research approaches and strategies is provided with justifications for those employed. The research design is then explicated - both data collection methods and data analysis procedures are described in a chronological manner. Describing the data collection methods and data analysis procedures in a chronological style was necessary since this research was progressive. This will benefit researchers who aim to replicate the study in other contexts. Figure 4.1 presents a flowchart of this chapter's layout.

Figure 4.1: Research Methodology’s chapter layout



4.2 Research Philosophy

It is clear from the literature that the project management discipline is challenged by various aspects. Meeting a construction project's iron triangle of scope, budget and time is proven not easily achievable. Countless constraints and forces influence how projects are managed and delivered in different parts of the world. The research philosophy adopted in this study is influenced by practical considerations. The main consideration that influenced important assumptions of how the world is viewed in this study is expressed by Hofstede (Hofstede, 1983):

> management in general, and project management in particular, can be related to differences in national cultures and these differences may become one of the most crucial problems for management, particularly in multi-national organizations whether public or private … the major real obstacles in the field of transfer of project management practices and know-how are the socio-cultural factors.
>
> cited in (Al-Saqer, 2001)

From this ground, where the researcher has aimed to conceptualise project implementation challenges as perceived by various social actors in the Saudi Arabian electricity industry, social constructionism philosophy advocates the purpose of this research and, hence, is adopted.

Social constructionism follows from the interpretivist position that asserts the necessity to understand differences between humans and their roles as social actors (Saunders *et al*., 2007). Unlike the positivist position, where the research is isolated from, and independent of, the research social actors' thoughts, interpretivism is highly reliant on social actors' feelings and interpretations.

“Social constructionism views reality as being socially constructed” (Saunders *et al*., 2007). It explores the subjective meanings motivating the actions of various social actors (or project stakeholders in this research case) in order to understand the collective behaviours. These may result in many different perceptions and interpretations as a consequence of each individual viewing the world differently. Having a wide range of influential project stakeholders, these different perceptions and interpretations are likely to affect their actions and the nature of their interactions with other project stakeholders. Therefore, the research seeks to understand the subjective reality of project stakeholders’ actions to make sense of the reasons behind the creation of project challenges and their management. On this basis, the study aims to explore the reality, which is socially constructed, behind project challenges in the investigated industry (Remenyi et al., 1998).

The research has also embraced ‘pragmatism’, an approach which implies that the most important determinant of the research philosophy adopted is the research question. The value of answering the research question is believed to have a tangible impact on the investigated project industry in Saudi Arabia. According to Tashakkori and Teddlie (1998, cited in Saunders *et al*., 2007), pragmatism is intuitively appealing since, in their view, a researcher should “study what is of value to [the researcher], and use the results in ways that can bring about positive consequences within [the researcher’s] value system”. This is portrayed in the researcher’s desire to influence existing policies surrounding and affecting the widening electricity supply-demand gap in Saudi Arabia. This also includes, albeit indirectly, rectifying domestic energy consumption behaviour. The adopted policies are collectively believed to contribute to the creation of the identified project implementation challenges, as will be examined later (see Appendixes A and B). These challenges, in turn, have a direct impact on project management practice and performance in the very same investigated industry, and these are the main focus of this study.

4.3 Research Approaches

The process of developing theories in research involves either the adoption of a deductive approach, in which the research design tests the hypothesis, or an inductive approach, in which the theory is developed after the data are collected and analysed. The next two sections describe the difference between the two approaches.

4.3.1 Deductive approach

This approach "involves the development of a theory that is subjected to a rigorous test" called testing theory. It is usually used in the natural sciences where it predicts the occurrence of phenomena and allows their prediction (Collis and Hussey, 2003)

Normally there are five sequential stages in this research approach:

- Deduce a hypothesis from a theory through testing a proposition about the relationship between concepts
- Express the hypothesis in operational terms that explains the relationships between the concepts
- Test the formulated hypothesis using one or more strategies
- Examine the specific outcome of the test
- Conclude whether the theory needs modification in the light of the hypothesis test outcomes (Robson, 2002)

4.3.2 Inductive approach

This approach, otherwise described as “building theory”, is an alternative approach to deduction in which theory follows data rather than vice versa (Saunders et al., 2007). In contrast to the rigid methods of the deductive approach, the inductive approach tends to permit a flexible methodology to allow a feel for what is going on and to better understand the nature of the problem. Research using this approach may use a small sample of subjects when compared to deductive approach studies since it is likely to be concerned with more specific and narrowed contexts.

4.4 Research Strategies

This section is concerned with the selection of research strategies employed to answer the research questions. Choosing between various strategies was influenced by the research philosophy and approaches adopted in this study. Some common research strategies considered were the following:

4.4.1 Experiment

This strategy is usually used to uncover causal links between the investigated variables and aspects in both exploratory and explanatory research to answer ‘how’ and ‘why’ questions. This strategy typically involves the definition of a theoretical hypothesis and selection of samples of individuals from known populations. However, the restrictive design requirements of experiments make this strategy more applicable to the natural sciences, particularly psychology, when compared to this study’s social science orientation. Therefore, this strategy was viewed as not being appropriate for pursuing answers to this study’s research questions and objectives (Saunders et al., 2007).

4.4.2 Survey

This popular strategy is usually associated with the deductive approach and is most frequently used to answer 'who', 'what', 'where', 'how much' and 'how many' questions. It allows the collection of a large amount of data and tends to be used for exploratory and descriptive research (Collis and Hussey, 2003). This strategy is appropriate for this study since, by focusing on a large sample of project managers (this study's social actors), this research seeks to explore the degree of importance they assigned to the identified project delay factors. This is followed by a description of the existing literature and a comparison of similarities and differences with the data collected for this study (Robson, 2002).

4.4.3 Case Study

This strategy is useful for gaining a rich understanding of a research context through generating answers to considerable numbers of 'why', 'what' and 'how' questions. It is defined as "a strategy for doing research which involves an empirical investigation of a particular contemporary phenomenon within its real life context using multiple sources of evidence" (Robson, 2002). This strategy is employed in this research through the use of multiple sources of data. The use of different data collection techniques within one study ensures the analysis results in what is known as "triangulation". This study used documentary, semi-structured interviews and survey questionnaire analysis, as will be seen below, to look for and establish consistency in the results of the data analysis.

4.4.4 Action research

This strategy motivates the involvement of the practitioners in the study with the researchers who are concerned with the resolution of organisational issues. It requires a collaborative working climate between both the practitioners and the researchers for best outcomes (Saunders et al., 2007). It normally goes through spiral cycles of iterative processes of diagnosing, planning, taking action and evaluating. Starting with a clear research purpose and specific context, the diagnosis process refers to fact finding followed by thorough analysis to enable action planning, which means a decision about the necessary actions. The evaluation of these actions concludes the first cycle before the next cycle commences to diagnose, plan and take action for another research problem. This strategy was viewed as being highly appropriate for this study; unfortunately, however, the reluctant nature of the research subjects prevented the use of this strategy.

4.4.5 Grounded theory

This strategy is particularly helpful for predicting and explaining behaviour by developing and building theories (Goulding, 2002). It is useful for the exploration of a range of business and management issues. In this study, grounded theory is considered one of the main research strategies since data were collected without the formation of an initial theoretical framework. Theory is then developed from the collected data with the assistance of a series of observations and predictions that are tested in further investigations (Collis and Hussey, 2003; Charmaz, 2008).

4.4.6 Ethnography

This time consuming strategy is used to describe and explain the social world the research subjects inhabit in the way in which the world describe and explain it (Saunders et al., 2007). It is time consuming because the researcher needs to live in the social world of the research subjects for as long as possible; in addition, the research process needs to respond to changes in a timely manner. This research strategy is not common in the business field but it might have been appropriate if the research objective was to gain insights about a specific context from the social actors' perspectives.

4.4.7 Archival Research

This strategy mainly allows the answering of research questions that focus on aspects that change over time. Therefore, it is necessary to understand the past of these aspects through accessing historical records and documents as principal sources of data. However, it is important to note that these historical data could be stored and recorded for purposes different from those of the research main objectives (Saunders et al., 2007). For example, there were useful documents describing the historical development of the Saudi Arabian power supply industry. However, since these documents were published by the government, the presented facts and data flourished the government's roles and achievements in the development of the industry. Therefore, by interviewing experts in the field, the researcher faced the challenge of understanding how the problematic issues developed in the industry, which is a different context from that found in the examined documents.

4.5 Research design

This section focuses on detailing the strategies adopted for addressing and answering the research question. These strategies entailed methods of gathering data and the analysis procedures. Therefore, a clear set of research objectives derived from the original research question is used as a guideline to justify all decisions relevant to methods answering the main enquiry. The challenges surrounding projects in the investigated industry were never thoroughly addressed before this research project. Therefore, it was important to first explore what was happening in the industry to seek the most valuable and relevant questions. The purpose of the enquiry, for this reason, is progressive (Robson, 2002), where the focus is initially broad before it narrows as the research progresses (Saunders *et al*., 2007).

4.5.1 Methods of gathering data

This study had a progressive nature where one step informed the next. This entailed the employment of several methods for gathering data. This inductive approach, where a theory is built after analysing the collected data (Saunders *et al*., 2007), adopted mixed and non-rigid methods, and these are listed in a chronological manner (see Table 4.1). It was necessary to place brief presentations of data analysis results in the following sections to justify why each data-collection method was utilised. The research setting and demographics of the social actors who participated in this research are demonstrated in the following sections below.

Table 4.1: Summary of data-collection phases

Phase	Data collection-method	Rationale	Focus level and context notes	Key stakeholders
I	Review of relevant literature Semi-structured interviews	Explore research problem and significance Formulate research questions and objectives	Broad Global oil market Saudi Arabian domestic political and social forces	Government Local Authorities Electricity users Private investors
II	Semi-structured interviews Review of relevant literature Questionnaire survey	Describe the most important PDFs* Form a conceptual model of PICs**	In-depth Key stakeholders relationship	SEC Contractor Consultants
III	Semi-structured interviews Review of relevant literature	Explain PDFs interrelationships Validate PICs conceptual model	In-depth Key stakeholders relationship	SEC Contractor Consultants
		Suggest possible reforms and applicable recommendations	Broad Saudi Arabian economy and relevant policies	Government Electricity users Private investors International oil market stability
			In-depth Project management practice	SEC

*Project Delay Factors

**Project Implementation Challenges

4.5.1.1 Review of relevant literature I

The initial step aimed to review how electricity has become an indispensable element in human society (to those who are blessed with access) and its role in global economic growth. This was followed by an identification of the challenges facing the sufficient provision of electricity and its potential impact on both economic and environmental wellbeing. Particular focus was confined to the challenges facing the Saudi Arabian electricity industry. The review also included an understanding of the role of project management in various industries through the examination of text books, academic journals and conference papers. A focused attention at this stage was given to comprehension of project success and its relevant factors. This stage also included a review of sources relevant to the Saudi electricity supply industry, such as government publications and local and international media, in addition to the SEC annual reports.

4.5.1.2 Semi-structured interviews Phase I

In this concise stage phase of gathering primary data, semi-structured interviews were conducted to broadly explore the challenges surrounding the electricity supply industry in Saudi Arabia. Formal letters were sent to four different authoritative figures in the industry in which the general purposes of the research were explained. These letters presented the need to address the existing challenges and their role in impeding project progress. These potential participants were close to the decision-makers in the industry and, therefore, their influential roles meant their beliefs and thoughts would shape valued research questions and objectives. These targeted figures were:

1) Mahmoud Taibah (Mercy be upon him), engineer, Vice Chairman of the Shura Council (which was always described as an equivalent to Parliament but with no authority) and Chairman of the Saudi Electricity Company Board of Directors.

2) Dr. Saleh Al-Awaji, Deputy Minister of Electrical Affairs and Vice Chairman of the Saudi Electricity Company Board of Directors at the time (currently he is the Chairman of the Board).

3) Dr. Bakr Khoshaim, ex-Managing Director of SCECO West, power consultant and member of the Shura Council.

4) BASH, engineer and Executive Vice President of the Saudi Electricity Company (Western Operating Area).

Engineer Taibah kindly accepted an invitation to be interviewed in order to address and tackle the challenges surrounding the industry but, at the time, he was sick and the interview did not take place. His eventual death was considered an unbearable loss for the industry. The remaining three respondents took part in this phase. All three interviews immediately started without any kick-off question, which indicated that the previously sent letter (Appendix C) had properly addressed the research scope. This also indicated that the participants wanted to take the lead to uncover what they valued as urgent aspects.

The first respondent was Dr. Saleh Al-Awaji, Deputy Minister of Electrical Affairs, who mainly thought that the current challenges facing the electricity supply industry at present resulted from relevant historical decisions and of adopted policies through time. He was the one who most expressed a genuine concern about the supply projects not being able to cope with the increasing demand for electricity. The analysis of the results will explore this issue in detail in the following chapter.

The second participant was Dr. Bakr Khoshaim, ex-Managing Director of the previously called Saudi Consolidated Electricity Company in the Western Region (SCECO West), who retired just before forming the SEC. He also expressed concern about not applying necessary industrial and regulatory reforms in a timely manner, but he was highly reluctant to elaborate on these reforms. Rather, he focused on project operational level problems, which was very useful as it gave a brief comparison between project management practice in the past and present and whether any change had taken place. The interview contributed to an understanding of why projects lacked clarity of deliverables requirements, a challenge that had a negative influence on maintaining a healthy owner-contractor project relationship, especially during construction. He also expressed concern, as did Dr. Al-Awaji, about projects not being able to cope with the increasing demand of electricity through timely project authorisation (project budget allocation) and delivery (project closure for those under construction).

The third participant was BASH, engineer and Executive Vice President of the SEC. The main outcome of the interview was his belief that the project industry is not privileged with [fully] successful projects. He explicitly indicated that power projects were unsuccessful due to their not being operated on time and that project delay was an accepted phenomenon in the industry. The participant preferred not to record the interview.

4.5.1.3 Semi-structured interviews Phase II

The research had progressed by the end of 'semi-structured interviews Phase I' to where the context was narrowed to identify relevant project problems rather than government policy challenges. This phase focused on authorised projects (i.e. those where relevant budgets were allocated and SEC top management approved the tendering of these investigated projects). The main objective of semi-structured interviews in this phase was to have a closer look at the daily operational life in the electricity supply industry projects and to identify problems that impeded their progress. A letter was written to the SEC Executive Vice President (Western Operating Area) to request permission and access to collect necessary data from the targeted social actors in the Company. However, the researcher was notified that the SEC CEO and President was the only figure who was authorised to provide such permission and approval. The CEO and President (Engineer Ali Al-Barrak) did, thankfully, provide access permission in a letter within two days of the request and expressed his wish to successfully meet the research objectives (Appendix B).

Copies were made of the approval letter along with consent forms that briefly described the research topic, objectives and confidentiality agreement (Appendix C). These were necessary, especially since the researcher sought to record the interviews for thorough analysis. The main social actors targeted were project team members representing the owner (the Saudi Electricity Company - Western Operating Area) and their relevant contractor and consultant project managers. The researcher had available resources to best conduct the research in the Western Operating Area as he mainly lived there and had established a network of friends and colleagues working in the investigated industry. Western Operating Area accounted for 30.9% of total electricity consumption in the Kingdom, which was the highest when compared to other operating areas (30.7% in the Eastern areas, 30.6% in the Central areas and only 7.7% in the Southern Operating Areas) (ECRA, 2008).

The chosen social actors were believed to be involved in key phases of the project lifecycle, from inception to closure (Table 4.2 below). Therefore, they were more aware of specific problems and could describe what was happening in the project area. Semi-structured interviews contained a predetermined list of questions relevant to the participant's tasks and his department's roles in projects (Appendix F). These questions were followed by open questions which sought to discover what the common and important problems were based on the participant's experience with projects. Participants were given the opportunity to talk freely about events, behaviours and beliefs where their observations were prioritised. Their thoughts were followed by other non-determined questions which were immediately formed based on their answers as a means to pursue more in-depth investigation. The process of data gathering in this phase, however, was not a linear process as many challenges were faced that threatened the ability to achieve the research objectives. These challenges were evidence of cultural barriers where participants in general were not willing to discuss project problems.

Table 4.2: Participant profiles for the recorded semi-structured interviews

	Participant	Project Industry			Organizational role	Project role	Semi-structured interview		
		PG	PT	PD			Phase 1	Phase 2	Phase 3
1	AJ	-	X	X	Contractor	PM + Sales	-	X	-
2	ASAL	X	-	-	SEC	PM	-	-	X
3	ABAB	X	-	-	SEC	PM	-	X	X
4	Awaji	X	X	X	SEC/Gov	Gov.	X	-	X
5	BARAK	-	X	-	SEC	PM	-	X	X
6	GARA	-	X	X	Contractor	PM	-	X	X
7	HM	-	-	X	SEC	PM	-	X	X
8	Khushaim	X	X	X	SEC/Gov	Executive	X	-	-
9	ABADI	-	-	X	SEC	PM	-	X	X
10	NAF	-	X	-	SEC	Planning	-	X	-
11	ORFA	-	X	-	SEC	PM	-	X	X
12	SAF	X	-	-	SEC	PM	-	-	X
13	SAR	-	X	-	SEC	Contract Mgr	-	X	X
14	JAWI	-	X	-	SEC	PM	-	X	X
15	WALA	-	X	-	SEC	PM	-	X	X
16	NABA	X	-	-	SEC	Specifications and Design	-	X	-
17	MAKI	X	-	-	SEC	Planning	-	X	-
18	MASHI	-	X	X	Contractor	Planning	-	X	-
						Total	2	14	12
					Total recorded interviews			28	

PG: Power Generation, PT: Power Transmission, PD: Power Distribution
PM: Project Manager
Gov.: Government

The questions considered for the semi-structured interviews were directly derived from the research questions and objectives. The questions in Appendix D were classified into three groups. The first group was described as “warm-up” questions which the researcher used to establish a relaxing questioning mode with the subjects and which allowed for an understanding of their personal interests in the ongoing projects. These questions were mainly focussed on the job description and their department roles in the managed projects. The second group was described as “exploration” questions. These questions were directly derived from the research objective seeking to identify the project delay factors in the investigated industry. Questions such as “Can you give examples of reasons contributing to the delay of your projects?” and “What are the most common project delay factors you faced in your projects?” have served to achieve the research objectives. The third group of questions were “sharpening” questions. Subjects were asked these questions in order to understand what actions and measures have been taken to mitigate the effect of the project delay factors they have identified by themselves. The fourth group of questions were described as the “revising” questions. These were asked to the subjects after revealing the questionnaire survey analysis results to confirm these results matched the subjects’ opinions. Questions such as the following were used: Do you think that the tendering system adopted by the SEC should be ranked as the most important PDF? Why do you think so?

As can be seen in Table 4.2, only two contractor project managers agreed to participate in the research and record the interview. The researcher had a close working relationship with these two managers and trust was established. The contractors generally felt that addressing project problems with the researcher could cause unnecessary problems with their client (SEC). Consultants were even more difficult to approach and only a single conversation rather than an interview was conducted. It was thought that uncertainty towards how the research findings would be presented was the main reason for their reluctant and minimal participation. This was the fact even though the researcher had arranged approval letters from their seniors to take part in the interviews.

Surprisingly, the researcher also faced great resistance from the Power Transmission Project Execution Department Manager, although the researcher had already secured written approval from the SEC President and CEO Engineer to access necessary information and data for the research. Yet, the Department Manager resisted the collection of data through recording of the interviews. The researcher placed high value on the recording of interviews where ‘rich’ data could be captured. It was eventually discovered that the resistance was due to a recent act by one of his subordinates who, secretly, had passed a few documents to a local newspaper. Publication of the contents of these documents had had a negative impact on the Company's public image. He conducted a series of investigations to identify the employee guilty of this misconduct. The Manager, therefore, thought that the researcher, as an outsider, was capable of publishing the interviews, especially when the research was about identifying project-relevant problems and the fact that such problems were topical for the Saudi media. Therefore, in this phase only twelve recorded interviews were conducted along with many unrecorded conversations. These assisted in the emergence of valuable themes.

The preceding discussion has demonstrated the severe challenges faced by the researcher in trying to uncover the root causes of project problems in the investigated industry.

4.5.1.4 Review of relevant literature II

During analysis of the interviews, several themes immediately emerged, as did more questions which needed to be tackled. Project delay was noticed to be not only a major problem in the industry but also an accepted phenomenon. Participants also referred to many reasons and factors contributing to project delay, and these have formed the ground for further and more focused investigations. Literature concerned with project delay factors in the utilities and construction industry was thoroughly examined. Factors contributing to project delay revealed by the conducted interviews were very similar in nature to those documented in the literature, which also guided how project delay factors could be classified and examined for further analysis and insights. Table 4.3 presents several data gathering methodologies in various construction PDF studies.

Table 4.3: Summary of PDF data collection methods in the literature

Table 5.2: Summary of PDF data collection methods in the literature

Study	Country	Methods of Collecting PDF data	
		Interviews	Questionnaire Survey
Shehu and Akintoye (2010)	UK	x	x
AlKharashi and Skitmore (2009)	Saudi	-	x
Sweis et al. (2008)	Jordan	-	x
Alaghbari et al. (2007)	Malaysia	-	x
Faridi and El-Sayegh (2006)	UAE	-	x
Assaf and Al-Hejji (2006)	Saudi	-	x
Long et al. (2004)	Vietnam	-	x
Odeh and Battaineh (2002)	Jordan	-	x
Lim and Mohamed (2000)	Malaysia	x	-
Al-Khalil and Al-Ghafly (1999)	Saudi	x	x
Mezher and Tawil (1998)	Lebanon	x	x
Chan and Kumarswamy (1997)	Hong Kong	-	x
Kaming et al. (1997)	Indon-nesia	x	x
Ogunlana et al. (1996)	Thailand	x	-
Assaf et al. (1995)	Saudi	x	x

As can be seen in Table 4.3 above, researchers have rarely relied solely on interviews to collect data, as was done in (Lim and Mohamed, 2000, Ogunlana and Promkuntong, 1996). The number of identified project problems and relevant delay factors was vast, and this required the focus to be narrowed to the most important ones. Therefore, it was necessary to employ a questionnaire survey to capture the most important PDFs for further understanding and analysis.

4.5.1.5 Questionnaire survey

Having the data representing a broad sample of social actors will provide more authoritative conclusions. Many PDFs were identified during the semi-structured interview analysis. Since PDFs were caused by various project stakeholders, and some were even caused by external forces, a questionnaire survey was employed to identify which of these were of greater concern. Previous studies have considered different numbers of PDFs. One study listed as many as 112 PDFs for further examination (Al-Kharashi and Skitmore, 2009), while another considered as little as 11 PDFs (Kaming *et al*., 1997) (Table 4.4). However, the content of all PDFs considered in previous studies were similar and repetitive and the differences were merely in how these were considered significant.

Table 4.4: Summary of PDF categories considered in previous research questionnaire surveys

Study	Country	Number of PDFs considered	O	C	E	ME	MP	PM	External
Shehu and Akintoye (2010)	UK	28	-	-	-	-	x	x	-
AlKharashi and Skitmore (2009)	Saudi	112	x	x	x	x	x	x	x
Sweis et al. (2008)	Jordan	40	x	x	x	x	x	x	x
Alaghbari et al. (2007)	Malaysia	31	x	x	x	-	-	-	x
Faridi and El-Sayegh (2006)	UAE	43	x	x	x	x	x	x	x
Assaf and Al-Hejji (2006)	Saudi	73	x	x	x	x	x	x	x
Long et al. (2004)	Vietnam	62	x	x	x	x	x	x	x
Odeh and Battaineh (2002)	Jordan	28	x	x	x	x	x	x	x
Lim and Mohamed (2000)	Malaysia	28	x	x	-	-	-	x	-
Al-Khalil and Al-Ghafly (1999)	Saudi	60	x	x	x	x	x	x	x
Mezher and Tawil (1998)	Lebanon	64	x	x	x	x	x	x	x
Chan and Kumarswamy (1997)	Hong Kong	83	x	x	x	x	x	x	x
Kaming et al. (1997)	Indon-nesia	11	-	-	-	x	x	x	x
Ogunlana et al. (1996)	Thailand	26	x	x	x	x	x	x	x
Assaf et al. (1995)	Saudi	56	x	x	x	x	x	x	x

O: Project owner, C: Project Contractor, E: Consultant Engineer
ME: Materials and equipments, MP: Manpower, PM: Project Management

The researcher carefully reviewed the PDF contents in the literature and compared these with the ones identified in the semi-structured interview analysis. The questionnaire survey used in (Al-Khalil and Al-Ghafly, 1999b) was identified as the most suitable questionnaire design on which to base the questionnaire for this project. This was because most of the analysed PDFs in the interviews conducted for this study were found in their questionnaire survey. Out of the 60 PDFs considered in (Al-Khalil and Al-Ghafly, 1999b), 56 of these were used for the purpose of this research questionnaire survey (Table 4.5).

Table 4.4 also showed that PDFs were also classified into several groups in the literature. These were either classified explicitly into the categories shown in Table 4.4, as done by the following researchers: (Al-Kharashi and Skitmore, 2009, Sweis et al., 2008, Alaghbari et al., 2007, Al-Khalil and Al-Ghafly, 1999, Assaf and Al-Hejji, 2006, Assaf et al., 1995, Chan and Kumaraswamy, 1997, Field, 2009, Long et al., 2004, Mezher and Tawil, 1998, Odeh and Battaineh, 2002, Ogunlana and Promkuntong, 1996), or based on the researcher's judgment since the examined PDFs were dealt with individually without any classification, as done by (Shehu and Akintoye, 2010, Lim and Mohamed, 2000, Kaming et al., 1997). The categories shown in Table 4.4 were the ones commonly identified in the literature (except for the PM – Project Management category which was less common). As the titles suggest, each project delay group is relevant to the given name. For example, project owner PDFs are those caused by an individual or a department which represented the project owner, as will be elaborated later. The same applies for project contractor and consultant PDF groups, where each of these PDFs indicates the root cause of delay is more relevant to either of these two. To an extent, key project stakeholders (project owner, contractor and consultant) contribute to project delay through facing problems, for example, in procuring adequate human and non-human resources that are essential for project progress. However, many of the identified PDFs are beyond any of the key project stakeholders' direct control. Therefore, these PDFs are categorised in either the Manpower PDF group or the Material and Equipment PDF group rather than grouping these under any of the key project stakeholder's groups.

There were other categories of PDF groups in the literature such as contract-related and contractual relationship-related PDF groups(Al-Kharashi and Skitmore, 2009, Assaf and Al-Hejji, 2006, Faridi and El-Sayegh, 2006, Odeh and Battaineh, 2002), financial-related PDF groups (Faridi and El-Sayegh, 2006), coordination-related PDFs (Long et al., 2004) as well as other groups that were addressed and examined separately. These were subjectively grouped under the 'Project Management' PDF group in Table 4.4 since 'Project Management' is a holistic discipline where it comprises all these PDF groups.

Table 4.5: List of the PDFs considered in the study

Serial	Project Delay Factor description
PDF 1	Shortage of materials required (e.g. cement, steel, bricks, etc.)
PDF 2	Delay in materials delivery
PDF 3	Changes in materials prices
PDF 4	Changes in materials specifications
PDF 5	Shortage of equipment required (transformers, drillers, switchgears, etc)
PDF 6	Failure of equipment
PDF 7	Inadequate equipment used for the works
PDF 8	Shortage of manpower
PDF 9	Low skill of manpower
PDF 10	Shortage of contractor's administrative personnel
PDF 11	Shortage of technical professionals in the contractor's organization
PDF 12	Poor communication by the contractor with the parties involved in the project
PDF 13	Contractor's poor coordination with the parties involved in the project
PDF 14	Slow preparation of change orders requests by the contractor
PDF 15	Ineffective contractor head office involvement in the project
PDF 16	Delay in mobilization
PDF 17	Loose safety rules and regulations within the contractor's organization
PDF 18	Poor qualification of the contractor's technical staff assigned to the project
PDF 19	Improper technical study by the contractor during the bidding stage
PDF 20	Ineffective planning and scheduling of the project by the contractor
PDF 21	There are no effective or realistic contingency plans in case the project is behind schedule or over budget
PDF 22	Delay of field survey by the contractor
PDF 23	Ineffective control of the project progress by the contractor
PDF 24	Inefficient quality control by the contractor
PDF 25	Delay in the preparation of contractor submissions
PDF 26	Difficulties in financing the project by the contractor
PDF 27	Cash flow problems faced by the contractor
PDF 28	Problems between the contractor and his subcontractors with regards to payments
PDF 29	Delay to furnish and deliver the site to the contractor by the owner
PDF 30	Delay in the settlement of contractor claims by the owner
PDF 31	Suspension of work by the owner
PDF 32	Delay in issuance of change orders by the owner
PDF 33	Slow decision making by the owner
PDF 34	Uncooperative owner with the contractor complicating contract administration
PDF 35	Delay in progress payments by the owner
PDF 36	Owner's poor communication with related government authorities
PDF 37	Owner's poor communication with contractors and consultants during project execution
PDF 38	Owner's failure to coordinate with government authorities during planning
PDF 39	Poor coordination by the owner with the various parties during project execution
PDF 40	Changes in the scope of project
PDF 41	Ambiguities, mistakes and inconsistencies in specifications and drawings
PDF 42	Site conditions materially differing from contract documents
PDF 43	Original contract duration is too short
PDF 44	Ineffective delay penalty
PDF 45	Difficulties in obtaining work permits
PDF 46	Owner's tendering system requirement of selecting the lowest bidder
PDF 47	Changes in government regulations and laws
PDF 48	Severe weather conditions on the job site
PDF 49	Effects of subsurface conditions (type of soil, other utility lines)
PDF 50	Traffic control and restrictions on the job site (difficulties to reach the site)
PDF 51	Effects of social and cultural conditions (Locals behavior and/or manpower different backgrounds)
PDF 52	Work interference between various contractors
PDF 53	Poor qualification of consultant engineer's staff assigned to the project
PDF 54	Delay in the approval of contractor submissions by the engineer
PDF 55	Poor communication between the consultant engineer and other parties involved
PDF 56	Poor coordination by the consultant engineer with other parties involved
PDF 57	Delay in performing inspection and testing by the consultant engineer
PDF 58	Slow response from the consultant engineer to contractor inquiries

4.5.1.5.1 Questionnaire survey design

Demographic questions

The first part of the questionnaire (Appendix G) was concerned with the participants' demographic information. Specifically, this information related to the following:

1) The participant's job (i.e. project manager, department/division manager, project engineer, or consultant engineer). This was used to describe the different tasks the research survey sample participants were responsible for and the level of involvement they had with day-to-day project details.

2) The participant's organisational role (i.e. project owner, contractor or consultant). This was used to examine whether the importance level of the surveyed PDFs was perceived differently or otherwise in order to establish further investigations and explanations for why these differences or similarities in perceptions were observed.

3) The participant's project experience (in years if applicable). This was used to illustrate the collective time experience the sample's findings were based on. The longer the sample's experience the more reliability could be awarded to their judgment of the findings.

4) The project type the participant has been involved in managing (i.e. power generation, transmission and/or distribution projects). Each of these project types were also broken down into gas turbine plants, steam turbine plants, CCGT plants (combined cycle generating turbine), substations, overhead transmission lines, underground cables, load dispatch centres and SCADA systems (supervisory control and data acquisition), distribution networks, diesel plants and rural electrification projects. These presented all project types and

divisions in the SEC. The researcher hoped to identify whether differences occurred in project management practices in these projects. Given the limited number of participants and coupled with the fact that each could have participated in more than one project type, differences tests were limited to the three main project activities of power generation, transmission and distribution projects.

Most important PDFs

The next section of the questionnaire was concerned with selecting the most important PDFs. PDFs in the literature were given several descriptions (Table 4.6). For example, (Sweis et al., 2008) and (Lim and Mohamed, 2000)identified PDFs in their studies and described these as “frequent”, while (Ogunlana and Promkuntong, 1996) described their addressed PDFs as “problems”. Similarly, this study’s participants described PDFs differently in the interviews that were conducted. For example, some were described as significant problems, some were described as frequent and some were described as having great influence and impact. All studies, including this one, strived to pinpoint which of the PDFs were sources of great concern to enable more practical remedies through consistent prioritisation of these PDFs. Therefore, to be firmly consistent and for the purpose of this study, the research sought to identify the “most important” PDFs in the Saudi Arabian electricity project supply industry. The most important PDFs are those likely to have a greater adverse impact on a project’s progress in the investigated industry. As can be seen in Table 4.6, most of the reviewed literature has described their identified PDFs as “important”. Following (Al-Khalil and Al-Ghafly, 1999, Assaf and Al-Hejji, 2006, Kaming et al., 1997) (Table 4.6), an important PDF was comprised of two characteristics: frequency of occurrence (i.e.

a measure of how often a PDF occurred in the investigated industry), and severity of impact (i.e. a measure of the extent to which a delay factor has actually contributed to a project).

Table 4.6: Summary of project delay factor descriptions in the literature

<table>
<tr><th rowspan="2">Study</th><th rowspan="2">Country</th><th colspan="3">PDF Descriptions</th></tr>
<tr><th>Frequent</th><th>Severe</th><th>Important</th></tr>
<tr><td>Shehu and Akintoye (2010)</td><td>UK</td><td colspan="3">Challenges</td></tr>
<tr><td>AlKharashi and Skitmore (2009)</td><td>Saudi</td><td colspan="3">PDF with effect</td></tr>
<tr><td>Sweis et al. (2008)</td><td>Jordan</td><td>x</td><td></td><td></td></tr>
<tr><td>Alaghbari et al. (2007)</td><td>Malaysia</td><td></td><td></td><td>x</td></tr>
<tr><td>Faridi and El-Sayegh (2006)</td><td>UAE</td><td></td><td></td><td>x</td></tr>
<tr><td>Assaf and Al-Hejji (2006)</td><td>Saudi</td><td>x</td><td>x</td><td>x</td></tr>
<tr><td>Long et al. (2004)</td><td>Vietnam</td><td>x</td><td colspan="2">and PDF with influence</td></tr>
<tr><td>Odeh and Battaineh (2002)</td><td>Jordan</td><td></td><td></td><td>x</td></tr>
<tr><td>Lim and Mohamed (2000)</td><td>Malaysia</td><td>x</td><td></td><td></td></tr>
<tr><td>Al-Khalil and Al-Ghafly (1999)</td><td>Saudi</td><td>x</td><td>x</td><td>x</td></tr>
<tr><td>Mezher and Tawil (1998)</td><td>Lebanon</td><td></td><td></td><td>x</td></tr>
<tr><td>Chan and Kumarswamy (1997)</td><td>Hong Kong</td><td></td><td></td><td>x</td></tr>
<tr><td>Kaming et al. (1997)</td><td>Indon-nesia</td><td>x</td><td>x</td><td>x</td></tr>
<tr><td>Ogunlana et al. (1996)</td><td>Thailand</td><td colspan="3">Problems</td></tr>
<tr><td>Assaf et al. (1995)</td><td>Saudi</td><td></td><td></td><td>x</td></tr>
</table>

Table 4.7: Frequency of occurrence and severity of impact weighting scales

Frequency scale				Severity scale			
Always	Often	Sometimes	Never	Extermely severe	Severe	Somewhat severe	No effect
4	3	2	1	4	3	2	1

Pilot Study

The questionnaire was prepared and written in two languages, Arabic and English. The English version was already established and was used as a reference to prepare the Arabic version. To avoid any misinterpretation, the researcher outsourced a translation service in Saudi Arabia which was approved by the British Embassy. The service provider was experienced in translating official documents from Arabic to English and vice versa. Five copies (three in Arabic and two in English) were distributed to participants in order to examine the clarity and completeness of the designed questionnaire survey. Two of the copies represented contractor project managers (English version) and three represented the SEC (Arabic version). The researcher was able to personally observe the filling in of four of these questionnaires. Among the useful comments given was the necessity to include PDF 21 ('No effective or realistic contingency plans in case the project is behind schedule or over budget'), as was mentioned in section 4.5.1.5. Moreover, the Project Execution Department Manager of SEC (Power Generation) suggested corrections for the demographic question part relevant to project types in all three sectors (i.e. Power Generation, Power Transmission and Power Distribution). Project types represented activities that were the basis of forming several Divisions working under the main Project Execution Department. The noticed mistakes were attributed to the lack of having a documented organisational chart in the SEC with sufficient details (i.e. the available documented information was limited with regard to an organisational chart in SEC where divisions under the Project Execution Department in each sector of Power Generation, Power

Transmission and Power Distribution were not documented). The pilot study surveys were not included in the analysis and three out of the five participants completed the final version of the questionnaire.

Final survey and collection

After considering all useful comments, the questionnaire was ready for official distribution for data collection (Appendix G). The pilot study was also used to calculate the average time required to complete the questionnaire, which was found to be 15 minutes. According to the pilot study participants, this was realistic, especially because the questionnaire was easy to understand and avoided the use of open questions. In general, participants were either cooperative in completing the survey or not at all. Some returned incomplete questionnaires. Incomplete questionnaires with up to five unanswered questions were returned to the participants to complete. It would be illuminating to understand why questions were not completed, but the researcher avoided asking the participants as this might, without being intentional, have caused embarrassment to the participants. The researcher had to write down the participant's name in the questionnaire cover page to return the ones with missing answers to the corresponding participant. But, in most cases, the researcher reviewed the questionnaires a few steps away from the participant, when convenient, to immediately return it if there was a missing answer. Incomplete questionnaires with more than five unanswered questions were disregarded.

The above table also showed that PDFs were also classified into several groups in the literature. These were either classified explicitly into the categories shown in Table 4.4, as done by the following researchers: (Al-Kharashi and Skitmore, 2009, Sweis et al., 2008, Alaghbari et al., 2007, Al-Khalil and Al-Ghafly, 1999b, Assaf and Al-Hejji, 2006, Assaf et al., 1995, Chan and Kumaraswamy, 1997, Field, 2009, Long et al., 2004, Mezher and Tawil, 1998, Odeh and Battaineh, 2002, Ogunlana and Promkuntong, 1996), or based on the researcher's judgment since the examined PDFs were dealt with individually without any classification, as done by (Shehu and Akintoye, 2010, Lim and Mohamed, 2000, Kaming et al., 1997). The categories shown in Table 4.4 were the ones commonly identified in the literature (except for the PM – Project Management category which was less common). As the titles suggest, each project delay group is relevant to the given name. For example, project owner PDFs are those caused by an individual or a department which represented the project owner, as will be elaborated later. The same applies for project contractor and consultant PDF groups, where each of these PDFs indicates the root cause of delay is more relevant to either of these two. To an extent, key project stakeholders (project owner, contractor and consultant) contribute to project delay through facing problems, for example, in procuring adequate human and non-human resources that are essential for project progress. However, many of the identified PDFs are beyond any of the key project stakeholders' direct control. Therefore, these PDFs are categorised in either the Manpower PDF group or the Material and Equipment PDF group rather than grouping these under any of the key project stakeholder's groups.

There were other categories of PDF groups in the literature such as contract-related and contractual relationship-related PDF groups(Al-Kharashi and Skitmore, 2009, Assaf and Al-Hejji, 2006, Faridi and El-Sayegh, 2006, Odeh and Battaineh, 2002), financial-related PDF groups (Faridi and El-Sayegh, 2006), coordination-related PDFs (Long et al., 2004) as well as other groups that were addressed and examined separately. These were subjectively grouped under the 'Project Management' PDF group in Table 4.4 since 'Project Management' is a holistic discipline where it comprises all these PDF groups.

4.5.1.6 Semi-structured interviews III

Quantitative analyses were conducted on the collected data to distinguish which of the surveyed PDFs were more important in the investigated industry. As will be explained next in more detail, ranking analysis was employed to identify the most important PDFs. After deciding which of these PDFs were "most important", Factor Analysis (Field, 2009, Shehu and Akintoye, 2010) was employed using the most important PDFs as the input variables to produce a model of the Project Implementation Challenges (PICs) in the investigated industry, which was this study's aim. The semi-structured interviews, which took place before distribution of the questionnaire survey, were full of rich data but were not able to reveal which of the identified PDFs were of more importance. Therefore, after applying the quantitative analyses, these previously conducted interviews were revisited with a more structured analysis plan (section 4.5.2.1) to improve the PICs model construct derived by Factor Analysis. Moreover, to gain more focused insights on the progressively constructed PIC model and its elements (the most important PDFs selected for this purpose), eleven additional semi-structured interviews (phase III) were conducted (Table 4.3). There were pre-determined questions to achieve this objective (Appendix H). There were also non-determined questions which were immediately formed on the spot based on the participants' answers to gain even further in-depth insights. Nine of the eleven participants who were interviewed in Phase III had been previously interviewed in either Phase I or Phase II (Table 4.3). Time limitations forced the selection of participants who took part in the previous phases as they were more likely to accept recording of the interviews. This presented a convenient opportunity to examine the consistency of the participants' responses in terms of whether or not they presented new perceptions and insights when compared to the previous interviews.

4.5.1.7 Review of relevant literature III

Both the energy industry and the project management discipline are fast developing areas. Therefore, it was necessary to keep the research as current as possible to maintain its value. For example, in the Saudi Arabian domestic energy policy context, an important amendment was recently applied to the highly subsidised electricity tariff in May 2010. This will have an impact on the relevant analysis conducted in the following chapter where the focus was on domestic energy policies and the impact of these on project management practice.

4.5.2 Analysis procedures

4.5.2.1 Interview analysis procedure

All conducted interviews in which participants agreed to be recorded were saved on a digital voice recorder (OLYMPUS WS-450S). The recorder was equipped with a USB memory stick and all saved interviews were uploaded to several PCs. The advantage of this voice recorder was that the uploaded files could be operated in any normal media player application (such as real player, Windows media player etc.) rather than a specific player application.

Since all interviews (except for one) were conducted in Arabic, these were transcribed in Arabic and then translated into English. The translation was a challenging process, as 'literal' translation would give the data irrelevant meaning. The translated transcripts were hand written. Most of the hand written transcripts were typed using

“Dragon Naturally Speaking 9.0” software. The software enabled the researcher to dictate the transcripts into Word documents and saved time.

NVivo 8 was used to analyze the interviews (QSR, 2009). This ‘Qualitative Data Analysis Software Package’ was equipped with administrative functions that arranged, ordered and sorted qualitative data in a manner that maximised the insights gained from the conducted interviews.

Listening closely to respondents and thoroughly reading the transcripts was challenging. The challenge was in condensing and conceptualising each of the respondent’s statements to make their tacit understandings explicit (Charmaz, 2008). This comprised attending closely to the respondent’s views through listening to their audio files and reading their transcripts repeatedly. One of the useful features of the semi-structured interview was the ability to adapt the interview questions to fit the respondent’s language and experience. This minimised the making of false assumptions about their meanings. Another challenge arose when noticing a series of contradictions in a participant’s statements. For example, statements relevant to criticising the top management of the SEC fluctuated from being supportive (i.e. the top management is helpful) to being ignorant (i.e. the top management is not fully aware of what is happening) in the very same interview for the very same context but in different intervals. These needed careful and intuitive decisions to be made regarding what interpretations should be considered. Cultural factors and the fact these interviews were being recorded were taken as reasons for such contradictions. For example, it would be understandable in Saudi Arabia, as in many organisational cultures, to applaud top management performance even if the participant personally believes otherwise. For longer interviews, however, participants felt more relaxed as formality transformed into a friendlier, non-rigid chat in the later parts of the interviews. These later parts of the interviews were then interpreted more easily than the very first parts.

Data coding was an iterative process. Charmaz (2008) states that “Coding is the process of defining what the data are about”. Data were first coded line-by-line in order to gain distance from the participant’s taken-for-granted assumptions about the material. This helped seeing the familiar anew where analytic sense started to spark. Line-by-line coding also steered the research into unforeseen areas and new questions arose that needed to be addressed in the following interview phases. This comprised giving the scripts (sentences and paragraphs) initial codes, and this was the starting point where the data were classified into themes. The initial coding was completed through functions known in NVivo 8 as ‘free nodes’. A node is a collection of interrelated verbatim about a specific theme. For example, for interview transcription such as the following the researcher decided to initially code the line as ‘Authority perception’ and ‘Top Management’:

> Researcher: Is there any lack of authority?
>
> ASAL (SEC PM): No, everyone here has the required authority. In fact, sometimes when we escalate problems to the Top Management they ask us to handle the situation ourselves.

When the researcher goes through other similar verbatim, whether by the same participant or by other participants, these lines (i.e. scripts with given codes of ‘Authority Perceptions’ and ‘Top Management’) can be collected in a manageable manner for more in-depth analysis in the later stages. Therefore, “free nodes” in Nvivo 8 were used as containers to catalogue relevant ideas behind the data and gather verbatim under specific themes for easier access. The researcher, therefore, was required to make careful decisions when describing these codes. Selective examples of initial coding are provided in Table 4.8.

Table 4.8: Examples of initial codes considered during interview analysis

	Participant	Organiza-tional role	Project role	Examples of initial codes (free nodes) using 'Nodes Most Coding' tool in Nvivo 8
1	AJ	Contractor	Project Manager and Sales	Project lifecycle Project learning Contractor's project planning control effectiveness SEC behavior
2	Dr. Awaji	SEC/Gov	Gov.	Research importance Electricity supply industry development Electricity users behavior Project success and factors
3	SAR	SEC	Contract Mgr	Tendering system Project contract and contractual relationships Financial delay factors Project specifications and design
4	JAWI	SEC	Project Manager	Project communication and coordination Project scope changes Delay responsibility perception SEC planning processes
5	MAKI	SEC	Planning	SEC policy and culture SEC top management Project partnership Organizational and personal development
6	NABA	SEC	Specs & Design	Materials and equipment Project tendering and awarding process Trust Project contract and contractual relationships

Charmaz (2008) notes that "line-by-line coding gives [the researcher] leads to pursue". Therefore, these initial codes were revised several times to prepare for focused coding and to pursue more in-depth analysis. It was decided that some initial codes had similar characteristics and, therefore, these codes were merged into more refined description and, as a consequence, the total number of 'initial codes' was decreased. This partially described focused coding, which also comprised stepping up the analytical process where the materials were categorised more accurately. Arranging the materials into categories utilised the 'tree nodes' function in NVivo 8. Tree nodes were used to group the initial codes (free nodes) with mutual characteristics under a parent node (focused code). This was an essential step since it moved the analysis forward to the study of the relationships between the categories which had emerged. This process also comprised writing memos where each category's properties were described and the conditions under which these categories arose were explained along with their consequences (Charmaz, 2008).

Memo-writing, using NVivo 8, was about capturing and recording ideas about, for example, the emerged data categories. The collective evolution of these ideas was developed in a narrative form, as will be seen in the analysis where categories (Project Implementation Challenges) were defined by giving each its analytical properties (the most important PDFs which were the basic elements that formed the final Project Implementation Challenges conceptual model). Memos were also used as a means to provide sufficient empirical evidence to support the categories' definitions and analytic claims. This systematic procedure enabled the researcher to demonstrate the connection between all relevant elements (data, codes, categories, memos etc.) by providing sufficient verbatim and, therefore, concepts were derived from these connections. These concepts, collectively, developed into grounded theory with the collaboration of the quantitative analysis.

4.5.2.2 Quantitative analysis procedures

Interviews provided rich data where the interrelations between project problems were better understood. However, these project problems were addressed based on participants' experience and project role, which varied from person to person. For example, an executive figure like Dr. Al-Awaji, Deputy Minister of Electrical Affairs, was concerned with the policy-relevant aspect which had a serious effect on financing projects. Table 5.8 presents his interview transcript's most recurring initial codes (i.e. the initial codes in which most of his verbatim materials belonged to). Similarly, one of AJ's (Contractor PM) concerns was 'SEC project behaviour' (Table 5.8), where he addressed both the lack of project ownership and the very slow decision-making mechanism adopted in his client's organisation (SEC). Therefore, each of the interviewed participants was concerned with a different set of problems based on his project role and experience. In addition to this, projects were widely known for their uniqueness, meaning each presented a different set of troubles and was impeded by various sets of PDFs. These differences, however, collectively created unwanted project practice patterns and trends. Uncovering these patterns and trends that represented the wider project industry practice has provided the study authoritative decisions in which relevant practice improvements were suggested and prioritised. This was achieved through collecting data using the designed questionnaire survey previously described in which it represented a broad population of project practitioners.

The questionnaire survey was entirely restricted to those who were described as project managers representing the key stakeholders of the SEC, Contractors and Consultants. Project managers (PMs) are believed to spend most of their times on the project phases, especially during construction where a contract has already been awarded to a contractor and all three key stakeholder PMs are keen to execute its terms promptly. For project phases where PMs were not entirely involved (i.e. before the project award and construction phase), these PMs were still able to identify how these phases' PDFs evolved (i.e. occurred in project planning or design phases, for example, rather than construction). Restricting data-collection using the questionnaire survey to only PMs enabled a more focused understanding of how important PDFs were perceived from a definite distance. Methods for quantitatively analysing PDFs in the construction industry are summarised in Table 5.9 below (next page).

Table 4.9: Quantitative analysis procedures in previous research

Study	PDF importance test method		Test applied to determine level of agreement between participant groups
	Ranking	Factor Analysis	
Shehu and Akintoye (2010)	x	x	-
AlKharashi and Skitmore (2009)	-	-	-
Sweis et al. (2008)	x	-	-
Alaghbari et al. (2007)	x	-	-
Faridi and El-Sayegh (2006)	x	-	x
Assaf and Al-Hejji (2006)	x	-	x
Long et al. (2004)	x	x	x
Odeh and Battaineh (2002)	x	-	-
Lim and Mohamed (2000)	-	-	-
Al-Khalil and Al-Ghafly (1999)	x	-	x
Mezher and Tawil (1998)	x	-	x
Chan and Kumarswamy (1997)	x	-	x
Kaming et al. (1997)	x	x	-
Ogunlana et al. (1996)	-	-	-
Assaf et al. (1995)	x	-	x

4.5.2.2.1 Sampling issues

The questionnaire survey was confined to project managers who worked in the Saudi electricity supply projects in the Western Operating Area. The SEC was the owner of the entire national grid (power transmission network) and the only licensed entity that distributed and delivered electricity to end users (except for a few negligible cases in remote areas). The SEC also had the major share of electricity generation, accounting for 81% of the Kingdom's total generation. In terms of number of power generation plants, the SEC fully owns 50 plants out of the 79 operating plants in the Kingdom. This is besides the shares it has in some of the remaining 29 plants and those under construction. Therefore, the SEC definitely has a majority of the project managers representing the 'owner' population. However, there was a difficulty in identifying how many project managers were working for the SEC. The SEC PMs official title in the Company was not entirely rigid. For example, the job title for the SEC PMs who worked, for example, in the Power Transmission sector was 'power transmission engineer'. Power transmission engineers also included project planning and project specifications and design engineers who worked in different divisions with a different project role. The following questions were asked to participant ORFA (SEC PM):

> Researcher: Can I know what your job title is and how long have you worked in this position?
>
> ORFA: Three years. Power transmission engineer but to the contractors we are known as project managers or project engineers at least.

This apparently suggested that the title "Project Manager" is, to some extent, not officially recognised. In other words, project management was not embraced as a professional and determined career. To illustrate, engineers who are supposedly 'project managers' could have assignments that require them to be relocated into entirely different jobs. For example, the Power Transmission Project Execution Manager (direct boss of project managers) had to re-assign project managers from managing projects into reviewing contractors' submitted invoices to progress their delayed payments.

The questionnaire survey also targeted main contractors who were awarded projects by the SEC. There was a list of qualified contractors who were allowed to bid for the SEC projects. In addition to this list being updated periodically, where existing contractors might be either disqualified for poor performance or new contractors might be recently qualified, the list was not accessible. However, even if the researcher had had access to the list of qualified contractors, it would not have been possible to estimate how many project managers were working in each contractor's organisation.

For the reasons mentioned above, convenience sampling using snowball strategy was adopted as it was the only viable option to gain as useful a sample of data as possible. As the name implied, sample elements were identified by convenience, whether through university colleagues, friends and through referral networks who were at the time working in the investigated industry. Snowball strategy suggests that the sample size grows like a rolling snowball. This sampling strategy is the preferred method to obtain responses when the random selection method has proven difficult (Sekaran, 2000, cited in (Sambasivan and Soon, 2007). Table 4.10 (next page) presents the number of respondents in the previous PDF studies and Table 4.11 (next page) demonstrates how many participants returned usable questionnaires for this research.

Table 4.10: Summary of number of participants recognised in the literature

Study	Country	Number of Participants			
		Owner	Contractor	Consultant	Total
Shehu and Akintoye (2010)	UK	na	na	na	119
AlKharashi and Skitmore (2009)	Saudi	24%	40%	36%	86*
Sweis et al. (2008)	Jordan	26	36	29	91
Alaghbari et al. (2007)	Malaysia	23%	37%	40%	78*
Faridi and El-Sayegh (2006)	UAE	0	52	46	93
Assaf and Al-Hejji (2006)	Saudi	15	23	19	57
Long et al. (2004)	Vietnam	36	46	27	109
Odeh and Battaineh (2002)	Jordan	0	82	19	101
Lim and Mohamed (2000)	Malaysia	10	30	0	40
Al-Khalil and Al-Ghafly (1999)	Saudi	10	23	12	45
Mezher and Tawil (1998)	Lebanon	11	15	10	36
Chan and Kumarswamy (1997)	Hong Kong	50	48	49	147
Kaming et al. (1997)	Indon-nesia	na	na	na	31
Ogunlana et al. (1996)	Thailand	na	na	na	30
Assaf et al. (1995)	Saudi	9	24	15	48

* As reported

Table 4.11: Research participants' roles

Project Organisation Stakeholder	Research Participant's Role		Total
	Project Manager	Dept/Div Manager	
SEC	27	6	33
Contractor	42	9	51
Consultant	20	1	21
Total	89	16	105

4.5.2.2.2 Respondent Groups

Research respondents were classified according to their organisational project roles and according to the project industry they worked in. The project main stakeholders (the SEC as the project owner, project contractors and project consultants) had different priorities in the investigated industry. However, all were keen to deliver projects on time. It was argued that each of these organisations' representatives (PMs in this study's case) had different perceptions towards which of the surveyed PDFs were identified as more important. These different perceptions were driven by their employer organisational differences and interests in these projects. In other words, although each PM, representing either the SEC, contractors or consultants, had different project experience and hence different personal perceptions towards a PDF's importance level, the collective perceptions of these PMs could be greatly affected by their organisational project role. Therefore, research respondents were divided into the SEC PMs, contractor PMs and consultant PMs in order to examine the emergent perceptions of each group and examine why these perceptions were different, if indeed they were, between these PM groups.

The electricity supply industry is large in size and the SEC is conveniently divided into three main business activities: power generation, power transmission and power distribution businesses. These activities, up to the time of writing, have been managed under a single entity by the same CEO and President, but each has been sufficiently large enough to be dealt with as a business sector with a distinguished Executive Vice President. The investigated projects under each of these sectors (i.e. power generation, power transmission and power distribution sectors) contained, to some extent, different characteristics. The size of power generation (PG) projects was much larger (in terms of number of activities in a single project and hence the value of contract) than those in power transmission (PT) projects and in power distribution (PD) projects. Although PT projects varied from very large projects, such as Extra High Voltage Transmission overhead line projects, to smaller substation construction projects, these were generally much larger than PD network projects. The number of projects in each sector was also different. There were more PT and PD projects than there were PG projects. The research was concerned with providing a holistic view of the PDFs surrounding the Saudi electricity supply projects. Given the varying characteristics of projects belonging to each business sector, they might have an effect on the importance level of each PDF. Therefore, the study took this fact into account and divided PM respondents according to their project industrial experience into PG, PT and PD project industries, as will be seen in detail in Chapter 5.

4.5.2.2.3 PDF Perspectives

The surveyed PDFs will serve as ingredients to construct the conceptual model of the Project Implementation Challenges. However, the 58 selected PDFs identified in the semi-structured interviews and in the literature were in simplified form and each was given a brief description in the questionnaire survey, as in Table 4.5. In the questionnaire survey, a PDF broadly indicated a specific event, circumstance, force, or constraint that contributed to project delay. In reality, however, each PDF was far more complex than the given description in the survey. One source of complexity was when attempting to find the root causes and origins of these PDFs. Another source of complexity is the interdependencies that exist between several PDFs, making it even more challenging to capture their dynamic interactions.

Finding the root causes which prompted these PDFs to develop is an essential step to take if practical and relevant recommendations are to be made. Therefore, the next rational step was to comprehend the complexities of these PDFs and select which of these could compose a Project Implementation Challenge in a manageable manner. One method for understanding the nature of these PDFs was to combine these individual factors into a meaningful set of groups to pursue further analysis.

It was observed that the 58 PDFs considered in this study had various attributes. Those with common attributes could form a group of factors with meaningful and common characteristics. Grouping PDFs into distinguished sets adopted an intuitive and subjective approach in this study. As was mentioned in section 4.5.1.5, the PDFs identified in the literature were either classified into one of the categories shown in Table 4.4 or based on the researcher's subjective judgment when the relevant studies did not group their identified PDFs. For its subjective nature, there was an apparent absence of a systematic approach as to how the surveyed PDFs could be grouped. There are, however, common categories which can be recognised repeatedly in the literature and most of these were identified in Table 4.4.

This research study adopted two different approaches in which the 58 surveyed PDFs were perceived and then grouped. The motivation was to examine whether any insights could be gained from analysing the PDF groups from different perspectives. The first was the most common approach in the literature where the main theme of establishing the PDF groups was the organisation responsible for causing the relevant PDFs. Groups under this approach to classification (C1) obviously included the following: Owner (16 PDFs), Contractor (17 PDFs) and Consultant Engineer (7 PDFs) (see Table 4.12). The remaining groups under this classification approach (C1) were of an even more subjective nature. Human and non-human resources are the main elements of any project and the three key project stakeholders were to some extent responsible for procuring suitable and relevant resources. However, understanding the climate surrounding the project environment in Saudi Arabia motivated the researcher to group PDFs relevant to human and non-human issues into Manpower (4 PDFs) and Material and Equipment (7 PDFs) groups rather than grouping these directly under either of the three key project stakeholders. Manpower PDFs were influenced more by cultural and political forces and these were beyond any of the key project stakeholder's control. Material and Equipment PDFs were also, to a great extent, linked with external suppliers and manufacturers and with volatile supply-and-demand conditions. Therefore, these PDFs were addressed independently from the key project stakeholders. This was similar for the External PDFs group (7 PDFs), where these, as the name suggests, considered forces contributing to project delay but were not directly relevant to any of the other previously referred groups.

The other adopted approach to PDF grouping was less common in the literature. In fact, the only reviewed study that considered grouping the surveyed PDFs but did not consider grouping these directly under an organisation's responsibility was (Mezher and Tawil, 1998). Their 64 PDFs were grouped into the following 10 sets: Material, Manpower, Equipment, Financing, Changes, Government relations, Project Management, Site conditions, Environment and Contractual Relationships. In this study, groups under the adopted approach of classification (C2), where PDFs were classified regardless of which project key stakeholder organisation was responsible, included the following: Material and Equipment group (7 PDFs), Manpower group (6 PDFs), Contract/Contractual relationship group (4 PDFs), Communication group (9 PDFs), Planning group (5 PDFs), Execution group (9 PDFs), Monitoring and Controlling group (5 PDFs), Financial aspects group (4 PDFs), Stakeholder regulations group (5 PDFs) and External group (4 PDFs). The Material and Equipment PDFs group used the same rationale in (C1). The Manpower PDFs group, on the other hand, included 6 PDFs compared to 4 PDFs in (C1). The difference was the inclusion of both PDF 18 ('Poor qualification of the contractor's technical staff assigned to the project') and PDF 53 ('Poor qualification of consultant engineer's staff assigned to the project') in this (C2) Manpower PDFs group. In the previous PDF grouping approach - (C1) approach - where the main classification was based on the organisation's responsibility, these two PDFs (i.e. PDF 18 and PDF 53) clearly indicated direct flaws in the contractor's and consultant's hiring process criteria. Therefore, these two PDFs (PDF 18 and PDF 53) belonged to Contractor and Consultant PDFs groups respectively in the (C1) classification approach, while these also belonged to Manpower PDFs group in the (C2) classification approach (Table 4.12).

The Contract/Contractual relationship PDFs group included, as the name suggests, factors relevant to flaws or ineffective contractual terms such as PDF 42 ('Site conditions materially differing from contract documents'), PDF 43 ('Original contract duration is too short') and PDF 44 ('Ineffective delay penalty'). It also included the factor contributing to the uncooperative attitude of the owner (SEC) leading to a deteriorating contractual relationship with the contractor as in PDF 34 ('Uncooperative owner with the contractor complicating contract administration'). Similarly, the Communication PDFs group included relevant issues where poor communication contributed to the delay. All PDFs under this group were self-explanatory except for PDF 52 ('Work interference between various contractors'). It was intuitively decided to relate this PDF with the Communication PDFs group since this factor could have been avoided or at least minimised if there was effective communication between the relevant parties. The example presented an example of the subjective nature of how these PDFs were grouped, whether using (C1) or (C2) approaches.

As was mentioned above, the intention was to examine whether any insights could be gained from analysing the PDF groups from different perspectives. Doing this would allow project management practitioners and academics to further investigate methods to improve the current practice in a more authoritative style, assuming new insights were captured.

Table 4.12: List of PDFs grouped using two approaches of classifications (C1) and (C2)

No.	C1	C2	Cause of delay
1	ME	ME	Shortage of materials required (e.g. cement, steel, bricks, etc.)
2	ME	ME	Delay in materials delivery
3	ME	ME	Changes in materials prices
4	ME	ME	Changes in materials specifications
5	ME	ME	Shortage of equipment required (transformers, drillers, switchgears, etc)
6	ME	ME	Failure of equipment
7	ME	ME	Inadequate equipment used for the works
8	M	M	Shortage of manpower
9	M	M	Low skill of manpower
10	M	M	Shortage of contractor's administrative personnel
11	M	M	Shortage of technical professionals in the contractor's organization
12	C	Com	Poor communication by the contractor with the parties involved in the project
13	C	Com	Contractor's poor coordination with the parties involved in the project
14	C	Exec	Slow preparation of change orders requests by the contractor
15	C	MC	Ineffective contractor head office involvement in the project
16	C	Exec	Delay in mobilization
17	C	SR	Loose safety rules and regulations within the contractor's organization
18	C	M	Poor qualification of the contractor's technical staff assigned to the project
19	C	P	Improper technical study by the contractor during the bidding stage
20	C	P	Ineffective planning and scheduling of the project by the contractor
21	C	P	There are no effective or realistic contingency plans in case the project is behind schedule or over budget
22	C	P	Delay of field survey by the contractor
23	C	MC	Ineffective control of the project progress by the contractor
24	C	MC	Inefficient quality control by the contractor
25	C	Exec	Delay in the preparation of contractor submissions
26	C	Fin	Difficulties in financing the project by the contractor
27	C	Fin	Cash flow problems faced by the contractor
28	C	Fin	Problems between the contractor and his subcontractors with regards to payments
29	O	Exec	Delay to furnish and deliver the site to the contractor by the owner
30	O	Exec	Delay in the settlement of contractor claims by the owner
31	O	SR	Suspension of work by the owner
32	O	Exec	Delay in issuance of change orders by the owner
33	O	Exec	Slow decision making by the owner
34	O	CCR	Uncooperative owner with the contractor complicating contract administration
35	O	Fin	Delay in progress payments by the owner
36	O	Com	Owner's poor communication with related government authorities
37	O	Com	Owner's poor communication with contractors and consultants during project execution
38	O	Com	Owner's failure to coordinate with government authorities during planning
39	O	Com	Poor coordination by the owner with the various parties during project execution
40	O	P	Changes in the scope of project
41	E	MC	Ambiguities, mistakes and inconsistencies in specifications and drawings
42	O	CCR	Site conditions materially differing from contract documents
43	O	CCR	Original contract duration is too short
44	O	CCR	Ineffective delay penalty
45	Ex	SR	Difficulties in obtaining work permits
46	O	SR	Owner's tendering system requirement of selecting the lowest bidder
47	Ex	SR	Changes in government regulations and laws
48	Ex	Ex	Severe weather conditions on the job site
49	Ex	Ex	Effects of subsurface conditions (type of soil, other utility lines)
50	Ex	Ex	Traffic control and restrictions on the job site (difficulties to reach the site)
51	Ex	Ex	Effects of social and cultural conditions (Locals behavior and/or manpower different backgrounds)
52	Ex	Com	Work interference between various contractors
53	E	M	Poor qualification of consultant engineer's staff assigned to the project
54	E	Exec	Delay in the approval of contractor submissions by the engineer
55	E	Com	Poor communication between the consultant engineer and other parties involved
56	E	Com	Poor coordination by the consultant engineer with other parties involved
57	E	MC	Delay in performing inspection and testing by the consultant engineer
58	E	Exec	Slow response from the consultant engineer to contractor inquiries

C:Contractor CCR:Contract/Contractual relationship Com: Communication Processes E:Consultant Engineer Ex: External
Exec: Excecution Processes Fin: Financial aspects M:Manpower MC: Monitoring & Controlling Processes
ME:Material and equipment O: Owner P: Planning Processes

4.5.2.2.4 PDF ranking

PDF ranking was the most common method used where more important PDFs were distinguished from those less important (Table 5.9). As was previously mentioned, following (Al-Khalil and Al-Ghafly, 1999b, Assaf and Al-Hejji, 2006, Kaming et al., 1997), a PDF was comprised of the following two distinguishing characteristics: frequency of occurrence (i.e. how often a PDF occurred in the investigated project industry) and severity of impact (i.e. how much delay a factor has actually contributed to a project). The importance of each PDF was, therefore, measured in terms of the following:

a) Frequency index

Each participant was asked to rate each PDF according to its frequency of occurrence, which was classified from 'always' to 'never' on a four point scale (Table 4.13). The collected data were then analysed to calculate the frequency index of each PDF according to the participant group (i.e. SEC, Contractor, Consultant, PG, PT and PD project managers). The formula used was that used by (Al-Khalil and Al-Ghafly, 1999b, Assaf and Al-Hejji, 2006, Kaming et al., 1997):

$$\text{Frequency Index (F.I.) (\%)} = \sum a\,(n/N) * 100/A$$

where (a) was the constant expressing the weighting given to each response (range from 1 to 4), n was the frequency of the response, N was the total number of responses, and A was the highest weight (i.e. 4 in this case). To illustrate, contractor project managers assigned the following weights to the PDF 'changes in materials specifications': Always (2 participants); Often (7 participants); Sometimes (37 participants); and Never (5 participants). Therefore, the F.I. of the PDF according to the total of 51 contractor project managers was calculated as follows:

F.I. (%) = {[(4*2) + (3*7) + (2*37) + (1*5)] / 51} * 100/4 = 52.94

The same procedure was applied to the remaining PDFs where frequency indexes were derived according to SEC, Contractor and Consultant PMs. The frequency index for a PDF group was also determined as the average of the frequency indexes of all the PDFs in the group (Al-Khalil and Al-Ghafly, 1999b, Assaf and Al-Hejji, 2006, Mezher and Tawil, 1998, Odeh and Battaineh, 2002). For example, the frequency indexes of Consultant-related delay causes according to the SEC project managers were 60.61, 56.82, 56.06, 48.48, 56.06, 53.03 and 58.33 with respect to Table 4.12's PDFs (i.e. PDF number 41 and 53-58 respectively). Therefore, the frequency index of consultant-related factors according to the SEC project managers is the average of all frequency indexes in the group, which was 55.63. All the above were applied in the same manner to PMs according to their project industry type (i.e. PG, PT and PD project industries).

Table 4.13: Frequency of occurrence weighting scale (1-4)

Frequency scale			
Always	Often	Sometimes	Never
4	3	2	1

b) Severity of impact index

Severity of impact (how much delay a PDF has actually contributed to a project) was classified from 'very severe' to 'no effect' on a four point scale (Table 4.14). The collected data were then analysed to calculate the severity of impact index of each PDF according to the relevant participant group (i.e. SEC, Contractor, Consultant, PG, PT and PD project managers). The formula used was that used by (Al-Khalil and Al-Ghafly, 1999b, Assaf and Al-Hejji, 2006, Kaming et al., 1997):

$$\text{Severity of impact Index (S.I.) (\%)} = \sum a\,(n/N) * 100/A$$

where (a) was the constant expressing the weighting given to each response (range from 1 to 4), n was the frequency of the response, N was the total number of responses, and A was the highest weight (i.e. 4 in this case). To illustrate, contractor project managers assigned the following weights to the PDF 'changes in materials specifications': very severe (6 participants); severe (11 participants); somewhat severe (29 participants); and no effect (5 participants). Therefore, the S.I. of the delay factor according to the total of 51 contractor project managers was calculated as follows:

$$\text{S.I. (\%)} = \{ [(4*6) + (3*11) + (2*29) + (1*5)] / 51 \} * 100/4 = 58.82$$

The same procedure was applied to the remaining delay factors where severity of impact indexes were derived according to the SEC, contractor or consultant project managers. The severity of impact index for a PDF group was also determined as the average of the severity indexes of all the causes in the group (Al-Khalil and Al-Ghafly, 1999b, Assaf and Al-Hejji, 2006, Mezher and Tawil, 1998, Odeh and Battaineh, 2002). For example, the severities of impact indexes of consultant-related factors according to the SEC project managers were 72.73, 62.12, 66.67, 65.91, 67.42, 65.15 and 65.91 with respect to Table 4.12 PDFs (i.e. delay causes number 41 and 53-58 respectively). Therefore, the severity of impact index of consultant-related factors according to the SEC project managers was the average of all severity indices in the group, which was 65.56.

Table 4.14: Severity of impact weighting scale (1-4)

Severity scale			
Extermely severe	Severe	Somewhat severe	No effect
4	3	2	1

c) Importance index – two-dimensional measure

The importance index of each individual PDF and the PDF groups were then calculated as a function of both frequency of occurrence and severity of impact indices as follows (Al-Khalil and Al-Ghafly, 1999b, Assaf and Al-Hejji, 2006, Kaming et al., 1997):

(I.I.) = [F.I. * S.I.] / 100

For example, the PDF 'changes in materials specifications' had the values of F.I. = 52.94 and S.I. = 58.82 assigned by Contractor PMs. Therefore, the importance index value of this PDF was as follows:

I.I. = 52.94 * 58.82 / 100 = 31.14

Similarly, the importance indexes of the PDF groups were obtained. For example, the importance index of Consultant-related PDFs group according to the SEC project managers was as follows:

I.I. = 55.63 * 65.56 = 37.02

All delay causes were then ranked according to their importance indexes values as were perceived by the SEC, contractor, consultant, PG, PT and PD project managers. All PDF groups were also ranked as they were perceived by these project managers whether these PDFs were grouped according to classification approach (C1) or classification approach (C2).

Important PDFs

Although all PDFs must be taken seriously, each has presented a different level of importance. The argument of this research project was based on the different perceptions towards the identified PDFs collected and described in the interviews with various stakeholders (executives, project managers, project planning engineers etc.). Ranking their importance levels, however, was restricted to project managers, whether representing the SEC, contractors or consultants. These managers were believed to engage with everyday project details during the construction phase and, therefore, were able to pinpoint, based on their experience, which were of greater concern. They were also able to link problems faced during the construction phase to earlier phases where improper practices or actions took place (such as in the planning phase or during tendering etc.). To address these important problems which were described as PDFs, it was sensible to start with those valued as more important. For the purpose of this study, a PDF was considered highly important if its importance index value lay within the highest 10 values to a respondent group (SEC, contractor, consultant, PG, PT or PD project managers) (Alaghbari et al., 2007, Assaf and Al-Hejji, 2006, Faridi and El-Sayegh, 2006). These highly important PDFs were collectively described as the most important PDFs in the Saudi electricity project supply industry.

4.5.2.2.5 Agreement level test – Spearman rank correlation

Although the questionnaire survey was confined to project managers' responses, it was expected, as was previously explained, that it would show that there were different perceptions towards which constituted more important PDFs as a result of what these project managers (PMs) have experienced. Determining the agreement levels between the PMs' responses sought to explore what their varied perceptions were, if they existed, meant. Spearman rank correlation coefficient was used to show the degree of agreement between the SEC, contractor and consultant project mangers' in terms of their perceptions towards the importance of the delay causes (Assaf and Al-Hejji, 2006, Faridi and El-Sayegh, 2006, Long et al., 2004, Mezher and Tawil, 1998, Odeh and Battaineh, 2002). Spearman rank correlation is a non-parametric test where the data are not necessarily assumed to be normally distributed. This robust test was also applied to determine the agreement level between PG, PT and PD project managers towards the PDFs importance. The correlation coefficient values vary between +1, which implies perfect agreement, to -1 which means perfect disagreement. Values near zero indicate little or no correlation (Dancey and Reidy, 2004).

Table 4.15: Illustration of the strength of positive and negative correlation coefficients (Dancey and Reidy, 2004)

Perfect	+1	-1
	+0.9	-0.9
Strong	+0.8	-0.8
	+0.7	-0.7
	+0.6	-0.6
Moderate	+0.5	-0.5
	+0.4	-0.4
	+0.3	-0.3
Weak	+0.2	-0.2
	+0.1	-0.1
Zero	0	

The Spearman rank correlation coefficient r_s is calculated by the following formula (Assaf and Al-Hejji, 2006, Faridi and El-Sayegh, 2006, Long et al., 2004, Mezher and Tawil, 1998, Odeh and Battaineh, 2002, Dancey and Reidy, 2004):

$$r_s = 1 - [(6 \sum d^2) / (n^3 - n)]$$

where d was the difference between importance indexes assigned for each PDF, and n was the number of pairs of rank. The following example is based on the assumption there was a need to compare the ranking of three different items according to three different participants A, B and C. Participant A has assigned the values 60, 50 and 40 for items X, Y and Z respectively. Participant B has assigned the values 70, 65 and 45 for items X, Y and Z respectively. Finally, participant C has assigned the values 40, 50 and 70 for the items X, Y and Z respectively (Table 4.16).

Table 4.16: Ranking of items X, Y and Z as perceived by participants A, B and C

Item	Participant A		Participant B		Participant C	
	Value	Rank	Value	Rank	Value	Rank
X	60	1	70	1	40	3
Y	50	2	65	2	50	2
Z	40	3	45	3	70	1

The correlation coefficient between participant A and B was expected to be 1 because both have equally ranked the three items, although with different values, indicating perfect agreement. On the other hand, the correlation coefficient between participant A and C is -1 since the ranking of participant A to items 1, 2 and 3 was exactly the opposite of participant C. Therefore, it was expected to have a perfect disagreement coefficient value between the two. The provided example shows how Spearman rank correlation coefficient can indicate the degree of agreement between two participants towards their ranking for only three items. However, in this study the level of agreement between project owners and contractors, project owners and consultants, and project contractors and consultants towards the ranking of all 58 delay factors was examined. Moreover, the agreement level between the respondent sets (SEC, contractor and consultant project managers) towards the ranking of the delay causes groups was also examined. This procedure was repeated to determine the agreement between PG, PT and PD project managers. Finally, Spearman rank correlation coefficient will be used to determine the level of agreement between participants towards the ranking of PDFs within the corresponding group, as will be seen in detail in Chapter 5.

4.5.2.2.6 Factor analysis

Applying the previously explained importance ranking analysis on the 58 PDFs determined which of these were more important and which were less important. For the purpose of this research, highly ranked PDFs were those among the highest 10 PDF importance index values according to the SEC, Contractor, Consultant, Power Generation, Power Transmission or Power Distribution project managers and, therefore, these were considered the most important PDFs. The total number of these PDFs was 28, as will be detailed in the next chapter.

Having identified the most important PDFs, the use of ranking analyses along with Spearman rank correlation coefficients to understand the agreement levels between the research respondents were not suitable in comprehending how these highly ranked PDFs were arranged. Factor Analysis was used for this purpose since it was able to structure these PDFs in a meaningful set of components.

Factor analysis has been widely used to explore the structure of the correlations among a large number of variables. These correlations could be arranged in a manner that identified common dimensions where the list of the examined variables would be reduced and grouped into more manageable numbers (Shehu and Akintoye, 2010, Field, 2009, Long et al., 2004, Kaming et al., 1997). These 28 most important PDFs required further investigation when the PDF ranking analysis was not entirely conclusive when the research sought more in-depth insights. Therefore, factor analysis was applied to explore whether these PDFs could be statistically structured into meaningful components where a thematic construct could be achieved. An important assumption made before applying factor analysis was that the sample was homogeneous. Therefore, the sample was collectively treated as ‘Power Industry Project Managers in Saudi Arabia’ without any regard or assertion as to which organisations or project industry types participants have worked for. The PDF ranking analysis has evidently presented, as will be shown later, that the research participants' opinions were fairly non-biased. There was general agreement towards which organisation has generally accounted for most of the highly ranked PDFs. Therefore, the research sample of the 105 participants could legitimately be described as 'Power Industry Project Managers in Saudi Arabia'.

Factor analysis examined variance variability in the importance level of each PDF as measured by the participants. This indicates that rather than giving an importance value of a PDF based on the collective view of a participants group, as was conducted previously in the ranking analysis, each PDF would now have an importance weight according to each participant in this procedure. Therefore, since the importance level of each PDF was made of two main characteristics (i.e. frequency of occurrence level and severity of impact level), the value of a PDF's importance was the result of multiplying the frequency of this PDF's frequency of occurrence value by its severity of impact value. Each characteristic was dealt with as a one-dimensional measure. The multiplication of the two was equal to the value that exhibited the area between these two. Assuming the frequency of occurrence level of a PDF represented the x-axis and the severity of impact level of the same PDF represented the y-axis, then the value of this particular PDF's importance was the area between these two coordinate values. For example, if participant A has rated a PDF to occur (sometimes) but with (severe) impact on projects, then the importance level according to this participant will be the multiplication of the relevant scales of both (sometimes = 2) and (severe = 3) which is 6.

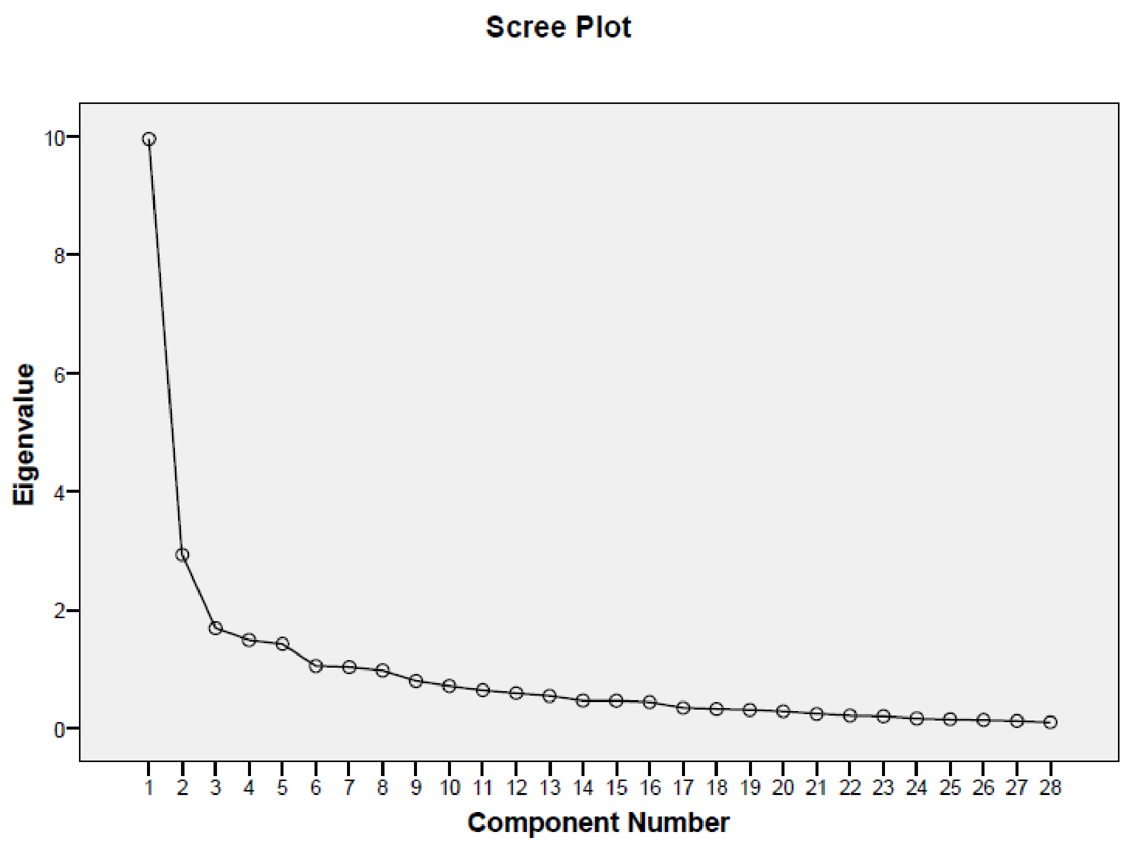
Sampling adequacy test

Factor analysis was run using SPSS v.15. Detailed steps for running the analysis using SPSS are described in (Field, 2009). There are few methods to assess whether the data were suitable to conduct Factor Analysis. One of the most common methods is Bartlett's test of sphericity and a Kaiser-Meyer-Olkin (KMO) of sampling adequacy test (Kaming et al., 1997, Long et al., 2004, Shehu and Akintoye, 2010). Bartlett's test of sphericity should be $p < 0.05$ to be significant. KMO index ranges from 0 to 1 with values closer to 1 are more favourable, indicating data are suitable for Factor Analysis, while values below 0.5 indicate otherwise (Field, 2009).

Factors (components) extract

Factor analysis is an exploratory tool that was used in this study to make various decisions regarding the number of factors (or components from hereon) to retain. Eigenvalues and Scree Plot analyses were conducted to extract and determine the set of components that would form the 28 top-ranked PDFs. The maximum possible number of components was the same as the number of PDF variables, which was 28. In other words, each PDF could form its component. However, it is desirable to retain components that consisted of all 28 top-ranked PDFs with the least possible number of components to address these PDFs in a more manageable manner. This was the role of both the Kaiser's test and the Scree Plot test to determine those principal components. The eigenvalue rule of Kaiser's test is a straightforward process where the number of components necessary to represent the examined data was selected for those with eigenvalues of 1.0 or more. Using Kaiser's criterion of eigenvalues of 1.0 or more often resulted in extracting and retaining many components (Field, 2009, Shehu and Akintoye, 2010). Therefore, it was important to also test the Scree Plot which involved plotting each of the component's eigenvalue to detect the point of inflexion. The point of inflexion was where the slope of the line changed dramatically to become horizontal. The components on the left of the inflexion point were with highest eigenvalues that should be retained (without including the inflexion point itself) (Field, 2009). The Scree Plot in this study has presented two inflexion points (at components 3 and 5 as in Figure 4.2, below).

Figure 4.2: Scree Plot used to determine the number of principal components (Project Implementation Challenges)



Factor loadings

The PDFs in which were the elements that made up the retained principal components contributed differently to each. The gauge of which each of the PDFs described its contribution to its principal components were called 'loading factors'. The higher the loading factor value of a PDF the more it contributed to the principal component. The loading factor represented the statistical significance of a correlation coefficient between the PDF (as an element) and its corresponding principal component (the Project Implementation Challenge). The minimum significance level of a factor loading depends on the sample size. The minimum loading value where it was considered significant for this study's sample size (105 participants) was 0.512 (Field, 2009).

4.6 Concluding Remarks

This chapter considered how to answer the research questions and achieve the research objectives stated in Chapters 1 and 2. Since the research aimed to frame a holistic view of the pressing Project Implementation Challenges in a specific industry where various forces played different roles to the contribution of their significance, social constructionism philosophy was adopted to pursue a comprehensive investigation. This philosophy has advocated the necessity to understand the differences between various relevant social actors to explore the subjective meanings of their perceptions, actions and collective behaviours.

The research study collected data in three phases. The first phase was meant to initially explore what was happening in the industry since this had never thoroughly been addressed. Reviews of relevant literature coupled with the conducting of semi-structured interviews progressively refined the research questions and objectives and provided a better understanding of the research significance. This was followed by phase II which sought to identify various PDFs by conducting semi-structured interviews with various practitioners in the industry. These interviews were followed by a questionnaire survey to identify which of these PDFs were most important according to the investigated industry project managers. Ranking analysis was employed for this purpose and 28 of the 58 surveyed were considered 'most important'. Factor Analysis was employed to structure these 28 most important PDFs to construct the Project Implementation Challenges (PICs) conceptual model. To provide a deeper insight, the final phase of data-collection (Phase III) sought to explain the most important PDFs interrelationships and validate the PICs conceptual model through conducting semi-structured interviews and a review of relevant literature. The investigation of these PDFs will lead to pragmatic recommendations that, if enacted, would minimise their significance.

5. Project Delay Factors Numerical Analysis

5.1 Introduction

The conducted interviews revealed various concerns from all respondents who participated in the research. The key concern was the problem of project delay, a phenomenon hampering the sufficient supply of electricity capacities in a timely manner. The questionnaire survey captured varying perceptions as to what constituted important Project Delay Factors (PDFs). This is because participants had different personal experiences, represented different organisations (i.e. the SEC, Contractor or Consultant) and were, in addition, involved in various project types (Power Generation, Power Transmission and Power Distribution). This chapter will present the numerical analysis results applied to the 58 surveyed PDFs which were explained in Chapter 4.

5.2 Questionnaire Participant Profile

A total of 105 participants completed the questionnaire survey (Table 5.1). The respondents included 33 participants from the SEC (31.4% of the sample), 51 participants from Contractor organisations (48.6% of the sample) and 21 participants from the outsourced Consultant engineers (20% of the sample). There is an apparent lack of clarity in the SEC as to what the responsibilities of a 'Project Manager' (PM) are or what the required skills set is that each PM needs to have. However, for the purposes of this research project, a PM is defined as a person who represents any of the three key stakeholder organisations (i.e. the SEC, Contractor or Consultant) and is considered the first line of contact for the project. The PM is continuously involved with the day-to-day project details and writes project progress reports for his superiors or clients on a periodic basis. There were 16 participants (15.2% of the sample) who were either Project Department or Project Division Managers (Table 5.1). In addition to being fully responsible for managing projects, these managers observed and viewed other PMs as subordinates. However, they can still be described as PMs. The remaining 86 participants (84.8% of the sample) were PMs without responsibilities relevant to superiors who direct other PMs and were fully engaged in managing projects.

Table 5.1: Research participant's roles in the key project stakeholders

Project Organisation Stakeholder	Research Participant's Role		Total
	Project Manager	Dept/Div Manager	
SEC	27	6	33
Contractor	42	9	51
Consultant	20	1	21
Total	89	16	105

The sample consisted of six Project Department/Division Managers from the SEC (18.2% of the SEC sample and 6% of the total sample) (Table 5.1), nine from Contractors (17.6% of the Contractor sample and 9% of the total sample) and only one from Consultant engineers (5% of the Consultant engineer participants' sample).

Table 5.2 shows that the average years of experience of the SEC Project Department or Division managers (20.3 years) was greater than those of Contractors (17.3 years) and Consultants (15 years). On the other hand, Table 5.3 shows that Consultant PMs, who were neither Project Department nor Project Division Managers, had more years of experience (14.3 years average) when compared to Contractor PMs (10.6 years) and the SEC PMs (9.5 years). The overall average years of experience of PMs with

Departmental or Divisional responsibilities and who directed other PMs was 17.5 years (Table 5.2). The overall average years of experience of PMs who were not Department or Division Managers was 11.6 years. The work experience context specifically referred to 'Project Management' expertise rather than general work experience in the industry since a participant could, for example, have worked as a sales engineer. This shows that although the sample was not large enough to infer any generalisation to the population, the collective 'Project Management' experience of the sample was substantial enough to draw sound conclusions on what was happening in the industry. From here on, all 105 participants will be referred to as Project Managers (PMs).

Table 5.2: Project Department/Division managers' years of 'Project Management' experience

Project Organisation Stakeholder	Number of Project Dept/Div Mgr	Minimum years of experience	Maximum years of experience	Average years of experience
SEC	6	10	31	20.3
Contractor	9	5	30	17.3
Consultant	1	15	15	15
Average	NA	10	25.3	17.5

Table 5.3: Project Managers' years of 'Project Management' experience

Project Organisation Stakeholder	Number of Project Managers	Minimum years of experience	Maximum years of experience	Average years of experience
SEC	27	1*	25	9.6
Contractor	42	1*	27	10.9
Consultant	20	2**	33	14.3
Average	NA	1.3	28.3	11.6

* Only one project manager
** Only two project managers

Table 5.4 presents in detail the project types the participants experienced. These participants had experience of working on Power Generation (PG), Power Transmission (PT) and/or Power Distribution (PD) projects. The PG, PT and PD columns in Table 7.4 show the number of PMs who had work experience in any of the three project types. The PG+PT+PD column in the same table shows the number of PMs who had work experience in all three project types. This shows that only 2 PMs representing the SEC and 5 PMs from Contractors had experience of working in all three project types of PG, PT and PD. The PG+PT column shows the number of PMs who had work experience on both PG and PT projects. It shows that 3 PMs from the SEC, 2 PMs from Contractors and only 1 Consultant PM had work experience on both PG and PT projects. Similarly, the PG+PD column shows that only two PMs from the SEC had experience of work on both PG and PD projects. The PT+PD column shows that 25 PMs from the sample had worked on both PT and PD projects. Most of these PMs (19 PMs) represented Contractors. This can be reasoned by the fact that some Contractors (such as Siemens and ABB) have business departments that deal with both PT and PD projects simultaneously. The last three columns show the number of PMs who had work experience in either of the three project types. These individuals had not had any experience other than the project type indicated in the column. 17 PMs had only worked on PG projects, 38 PMs had only worked on PT projects and 10 PMs had only worked on PD projects.

Table 5.4: Participants' experience according to PG, PT and PD project types

Project Organisation	Number of PMs	PG	PT	PD	PG+PT+PD	PG+PT	PG+PD	PT+PD	ONLY		
									PG	PT	PD
SEC	33	12	20	13	2	3	2	3	5	12	6
Contractor	51	9	45	28	5	2	Nil	19	2	19	4
Consultant	21	11	11	3	Nil	1	Nil	3	10	7	Nil
Total	105	32	76	44	7	6	2	25	17	38	10

Table 5.5 is a condensed version of Table 5.4 and shows how many PMs in each respondent group (SEC, Contractor and Consultant) had worked on multiple project

types and on single project types. It shows that 65 out of the 105 PMs had worked on either PG, PT or PD projects, while the remaining 40 PMs had worked on two or more project types.

Table 5.5: Comparison between Project Managers who have worked in single or multiple industries

Project Organisation Stakeholder	Number of participants worked in multiple project types	Number of participants worked in single project type	Total
SEC	10	23	33
Contractor	26	25	51
Consultant	4	17	21
Total	40	65	105

5.3 Highly Important PDFs – Organisational Perception

Table 5.6 below presents all 58 importance indexes according to PM groups that were divided into the SEC, Contractor and Consultant PMs. These PDFs were then ranked according to their importance index values, as described in Chapter 4. The higher the index value was the more important the PDF was according to the participant group. For the purpose of this research, highly ranked PDFs are those among the highest 10 PDF importance index values according to the ranking participant group. These highly ranked PDFs are distinguished by rectangular borders, as can be seen in Table 5.6. Collectively, these amounted to 22 PDFs, where each of these PDFs was at least among the 10 most important PDFs according to any of the three groups (Table 5.7). For example, PDF 29 was ranked 10th according to Consultant PMs and, therefore, was considered highly important, although it was ranked 16th and 28th by the SEC and Contractor PMs, respectively.

Table 5.6: Ranking of all 58 PDFs as perceived by the SEC, Contractor and Consultant PMs

	Owner		Contractor		Consultant	
PDF Serial no.	Imp. Index	Ranking	Imp. Index	Ranking	Imp. Index	Ranking
PDF 1	34.85	39	33.04	39	42.01	41
PDF 2	**47.81**	**2**	**48.48**	**4**	40.53	44
PDF 3	29.75	56	42.48	11	38.32	49
PDF 4	35.80	32,33	31.14	47	51.01	16-19
PDF 5	35.19	37,38	30.77	49	46.83	29
PDF 6	34.47	42	32.86	40	47.66	24-26
PDF 7	32.87	48	23.52	58	51.87	12,13
PDF 8	**41.71**	**10**	**48.62**	**3**	36.11	56
PDF 9	**41.78**	**9**	35.15	31	42.09	39,40
PDF 10	31.40	55	26.11	55	39.80	46-48
PDF 11	36.64	30	33.56	35	36.85	52-54
PDF 12	31.82	54	33.05	38	43.65	34
PDF 13	34.35	44	35.22	30	36.85	52-54
PDF 14	33.98	46,47	34.89	32	39.80	46-48
PDF 15	35.19	37,38	29.66	51	47.68	23
PDF 16	39.49	17	36.83	24	36.05	57
PDF 17	37.65	23,24	34.10	34	39.81	45
PDF 18	34.40	43	31.00	48	34.72	58
PDF 19	36.78	29	42.45	12	46.85	28
PDF 20	**41.84**	**8**	42.37	13	36.85	52-54
PDF 21	**44.35**	**4**	41.96	14	38.31	50
PDF 22	40.81	11	28.71	53	51.01	16-19
PDF 23	**42.42**	**7**	32.60	42	39.80	46-48
PDF 24	40.35	12	31.66	45	37.56	51
PDF 25	37.65	23,24	34.14	33	40.56	42,43
PDF 26	34.22	45	31.37	46	**55.36**	**5-7**
PDF 27	34.55	40,41	35.30	29	46.77	30
PDF 28	37.37	25-27	37.84	19	43.62	35,36
PDF 29	39.60	16	35.36	28	**53.60**	**10**
PDF 30	33.98	46,47	**42.50**	**10**	51.70	15
PDF 31	36.93	28	29.83	50	53.57	11
PDF 32	39.77	13-15	41.52	15	47.62	27
PDF 33	39.77	13-15	**44.76**	**6**	43.62	35,36
PDF 34	35.76	34	37.58	21	45.99	32
PDF 35	37.37	25-27	**43.42**	**8**	51.87	12,13
PDF 36	39.77	13-15	36.24	27	**58.93**	**2**
PDF 37	32.68	49	33.22	37	**57.14**	**4**
PDF 38	**42.83**	**6**	37.53	22	**64.57**	**1**
PDF 39	38.38	20	33.37	36	**58.04**	**3**
PDF 40	38.22	21	36.67	25	51.01	16-19
PDF 41	**44.08**	**5**	**42.95**	**9**	42.09	39,40
PDF 42	36.16	31	37.80	20	50.14	21
PDF 43	32.58	50	40.48	17	42.86	38
PDF 44	35.30	35,36	32.80	41	47.66	24-26
PDF 45	**44.39**	**3**	**45.33**	**5**	**55.36**	**5-7**
PDF 46	**54.38**	**1**	**50.43**	**1**	50.17	20
PDF 47	27.69	57	24.36	57	47.66	24-26
PDF 48	32.28	51	27.49	54	44.44	33
PDF 49	39.06	18	32.27	43	43.57	37
PDF 50	35.80	32,33	29.05	52	46.03	31
PDF 51	26.14	58	24.71	56	40.56	42,43
PDF 52	31.85	53	32.04	44	36.14	55
PDF 53	35.30	35,36	40.77	16	51.84	14
PDF 54	37.37	25-27	**49.38**	**2**	48.50	22
PDF 55	31.96	52	36.86	23	**54.46**	**8,9**
PDF 56	37.80	22	36.58	26	51.01	16-19
PDF 57	34.55	40,41	38.56	18	**55.36**	**5-7**
PDF 58	38.45	19	**44.64**	**7**	**54.46**	**8,9**

Table 5.7: List of the highly ranked PDFs according to the SEC, Contractor and Consultants PMs

Owner			Contractor			Consultant		
PDF	I.I	Ranking	PDF	I.I	Ranking	PDF	I.I	Ranking
46	54.38	1	46	50.43	1	38	64.57	1
2	47.81	2	54	49.38	2	36	58.93	2
45	44.39	3	8	48.62	3	39	58.04	3
21	44.35	4	2	48.48	4	37	57.14	4
41	44.08	5	45	45.33	5	26	55.36	5-7
38	42.83	6	33	44.76	6	57	55.36	5-7
23	42.42	7	58	44.64	7	45	55.36	5-7
20	41.84	8	35	43.42	8	55	54.46	8,9
9	41.78	9	41	42.95	9	58	54.46	8,9
8	41.71	10	30	42.50	10	29	53.60	10

No.	C1	C2	Cause of delay
2	ME	ME	Delay in materials delivery
8	M	M	Shortage of manpower
9	M	M	Low skill of manpower
20	C	P	Ineffective planning and scheduling of the project by the contractor
21	C	P	No effective or realistic contingency plans in case the project is behind schedule or over budget
23	C	MC	Ineffective control of the project's progress by the contractor
26	C	Fin	Difficulties in financing the project by the contractor
29	O	Exec	Delay in furnishing and delivering the site to the contractor by the owner
30	O	Exec	Delay in the settlement of contractor claims by the owner
33	O	Exec	Slow decision making by the owner
35	O	Fin	Delay in progress payments by the owner
36	O	Com	Owner’s poor communication with related government authorities
37	O	Com	Owner’s poor communication with contractors and consultants during project execution
38	O	Com	Owner’s failure to coordinate with government authorities during planning
39	O	Com	Poor coordination by the owner with the various parties during project execution
41	E	MC	Ambiguities, mistakes and inconsistencies in specifications and drawings
45	Ex	SR	Difficulties in obtaining work permits
46	O	SR	Owner's tendering system requirement of selecting the lowest bidder
54	E	Exec	Delay in the approval of contractor submissions by the engineer
55	E	Com	Poor communication between the consultant engineer and other parties involved
57	E	MC	Delay in performing inspection and testing by the consultant engineer
58	E	Exec	Slow response from the consultant engineer to contractor inquiries

I.I : Importance index

Tables 5.6 and 5.7 show that the only PDF that was considered highly important by all three respondent groups (the SEC, Contractor and Consultant PMs) was PDF 45 (**‘Difficulties in obtaining work permits’** from the relevant authorities). Moreover, both the SEC and Contractor PMs ranked PDF 46 (**‘Owner’s tendering system requirement of selecting the lowest bidder’)** 1st while it was ranked 20th by Consultant PMs. The SEC and Contractor PMs both ranked three more PDFs as highly important while these were not ranked as highly important by Consultant PMs

(Table 5.7). These were PDF 2 (**'Delay in materials delivery'**), PDF 41 (**'Ambiguities, mistakes and inconsistencies in specifications and drawings'**) and PDF 8 (**'Shortage of manpower'**). The only PDF that was ranked as being highly important by both the SEC and Consultant PMs, but not by the Contractor PMs, was PDF 38 (**'Owner's failure to coordinate with government authorities during planning'**). Similarly, the only PDF that was ranked as being highly important by both Contractor and Consultant PMs, but not by the SEC PMs, was PDF 58 (**'Slow response from the consultant engineer to contractor inquiries'**).

Agreement Level Test

Spearman Rank Correlation was applied to test for agreement between PMs towards the PDFs importance rankings, as described in section 4.5.2.2.5. First, the test was applied to examine the agreement levels between the SEC, Contractor and Consultant PMs towards all 58 PDF importance rankings. In this study, a PDF is assumed to only have the effect of delaying a project. In other words, a PDF is never assumed to cause a project to progress forward. Therefore, the significance level of Spearman Rank Correlation is tested for 1-tailed rather than 2-tailed. Table 4.15 can be used as guidance to describe the agreement level strength that can range from perfect agreement between two groups to perfect disagreement.

Table 5.8 shows that the SEC and Contractor PMs presented moderate agreement (r_s = 0.48) towards the importance rankings of all 58 PDFs, which was significant at the 0.01 level. The remaining two coefficients relevant to agreement levels between SEC-Consultant and Contractor-Consultant PMs were inconclusive since both were not significant. Similarly, Table 5.9 shows that when focusing on the 22 highly important

PDFs ranked by the SEC, Contractor and Consultant PMs, Spearman Rank Correlation results were inconclusive since these were not significant. Having non-significant coefficients was expected since the sample size in this case (i.e. 22 PDFs) was smaller than the previous larger size of 58 PDFs, which had already produced non-significant coefficients.

Table 5.8: Spearman Rank Correlation applied to all 58 PDFs between the SEC, Contractor and Consultant PMs

Project Managers Groups	Spearman rank correlation coefficient
SEC-Contractors	.48**
SEC-Consultants	0.02
Contractors-Consultants	0.06

** Significant at 0.01 level (1-tailed)

Table 5.9: Spearman Rank Correlation applied to the 22 highly ranked important PDFs according to the SEC, Contractor and Consultant PMs

Project Managers Groups	Spearman rank correlation coefficient
SEC-contractors	+.39
SEC-consultants	-.42
Contractors-consultants	-.38

5.4 Highly Important PDFs – Experienced Project Type Perception

The electricity supply industry can be divided into the three areas of Power Generation (PG), Power Transmission (PT) and Power Distribution (PD). The investigated projects under each of these areas did indeed have, to some extent, different characteristics, as described in section 4.5.2.2.2. The research was concerned with providing a holistic view of the PDFs surrounding the Saudi Arabian electricity supply industry. The differing characteristics of projects belonging to each industry area might have had an effect on the importance ranking of each PDF. Therefore, the study took this fact into account and divided PM respondents according to their project industrial experience into PG, PT and PD PMs. Table 5.10 (next page) presents all PDFs that were considered highly important by any of the three PG, PT or PD project manager groups. A highly important PDF is one which has any of the highest 10 PDF importance index values according to the ranking respondent group. Collectively, these amounted to 21 PDFs, where each is at least among the 10 most important PDFs according to any of the three groups.

Table 5.10: List of the highly ranked PDFs according to PG, PT and PD PMs

Power Generation			Power Transmission			Power Distribution		
PDF	I.I	Ranking	PDF	I.I	Ranking	PDF	I.I	Ranking
35	54.99	1	46	51.14	1	46	48.35	1
58	54.49	2	2	47.65	2	35	46.69	2
29	54.38	3	45	47.16	3	2	46.52	3
33	53.88	4	54	47.11	4	8	43.99	4,5
32	53.32	5	8	45.11	5	45	43.99	4,5
57	52.21	6	41	44.67	6	41	43.46	6
30	50.45	7,8	58	44.64	7	54	43.32	7
34	50.45	7,8	38	44.14	8	20	42.64	8
31	48.88	9,10	21	44.00	9	40	42.15	9
54	48.88	9,10	19	43.43	10,11	3	41.94	10
			20	43.43	10,11			

No.	C1	C2	Cause of delay
2	ME	ME	Delay in materials delivery
3	ME	ME	Changes in materials prices
8	M	M	Shortage of manpower
19	C	P	Improper technical study by the contractor during the bidding stage
20	C	P	Ineffective planning and scheduling of the project by the contractor
21	C	P	No effective or realistic contingency plans in case the project is behind schedule or over budget
29	O	Exec	Delay in furnishing and delivering the site to the contractor by the owner
30	O	Exec	Delay in the settlement of contractor claims by the owner
31	O	SR	Suspension of work by the owner
32	O	Exec	Delay in issuance of change orders by the owner
33	O	Exec	Slow decision making by the owner
34	O	CCR	Uncooperative owner with the contractor complicating contract administration
35	O	Fin	Delay in progress payments by the owner
38	O	Com	Owner’s failure to coordinate with government authorities during planning
40	O	P	Changes in the scope of project
41	E	MC	Ambiguities, mistakes and inconsistencies in specifications and drawings
45	Ex	SR	Difficulties in obtaining work permits
46	O	SR	Owner's tendering system requirement of selecting the lowest bidder
54	E	Exec	Delay in the approval of contractor submissions by the engineer
57	E	MC	Delay in performing inspection and testing by the consultant engineer
58	E	Exec	Slow response from the consultant engineer to contractor inquiries

As can be seen in Table 5.10, the only PDF that was highly ranked by all three PG, PT and PD PMs was PDF 54 (**‘Delay in the approval of contractor submissions by the engineer’**). Moreover, both PT and PD PMs ranked six PDFs ‘highly important’ while these were not ranked as highly by PG PMs (Table 5.11). These PDFs were PDF 46 (**‘Owner’s tendering system requirement of selecting the lowest bidder’**)**,** PDF 2 (**‘Delay in materials delivery’)**, PDF 45 (**‘Difficulties in obtaining works permits’**), PDF 8 (**‘Shortage of manpower’**), PDF 41 (**‘Ambiguities, mistakes and inconsistencies in specifications and drawings’**) and PDF 20 (**‘Ineffective**

planning and scheduling of the project by the contractor'). For example, PDF 46 (**'Owner's tendering system requirement of selecting the lowest bidder'**) was ranked highest by both PT and PD PMs, while it was ranked 28th by PG PMs.

Table 5.11: PDFs considered highly important by PT and PD PMs

PDF	PG ranking	PT ranking	PD ranking
46	28	1	1
2	18	2	3
45	26	3	4
8	32	5	4
41	21	6	6
20	56	10	8

PDF	**C1**	**C2**	**Cause of delay**
46	O	SR	Owner's tendering system requirement of selecting the lowest bidder
2	ME	ME	Delay in materials delivery
45	Ex	SR	Difficulties in obtaining work permits
8	M	M	Shortage of manpower
41	E	MC	Ambiguities, mistakes and inconsistencies in specifications and drawings
20	C	P	Ineffective planning and scheduling of the project by the contractor

PDF 35 (**'Delay in progress payments by the owner'**) was ranked 'highly important' by both PG and PD PMs (ranked 1st and 2nd respectively), while this PDF was not ranked as being highly important by PT PMs (ranked 17th) (Table 5.12). PG and PT PMs both ranked PDF 58 (**'Slow response from the consultant engineer to contractor inquiries'**) 'highly important' (ranked 2nd and 7th respectively), while this PDF was not ranked as highly by PD PMs (ranked 13th) (Table 5.13).

Table 5.12: PDFs considered highly important by PG and PD PMs

PDF	PG ranking	PT ranking	PD ranking
35	1	17	2

PDF	**C1**	**C2**	**Cause of delay**
35	O	Fin	Delay in progress payments by the owner

Table 5.13: PDFs considered highly important by PG and PT PMs

PDF	PG ranking	PT ranking	PD ranking
58	2	7	13

PDF	C1	C2	Cause of delay
58	E	Exec	Slow response from the consultant engineer to contractor inquiries

In terms of PDFs that were ranked 'highly important' only by PG PMs, these were caused by the SEC (except for PDF 57) (Table 5.14). These were PDF 29 (**'Delay in furnishing and delivering the site to the contractor by the owner'**) (ranked 3rd), PDF 33 (**'Slow decision making by the owner'**) (ranked 4th), PDF 32 (**'Delay issuance of change orders by the owner'**) (ranked 5th), PDF 57 (**'Delay in performing inspection and testing by the consultant engineer'**) (ranked 6th), PDF 30 (**'Delay in the settlement of contractor claims by the owner'**) (ranked 7th), PDF 34 (**'Uncooperative owner with the contractor complicating contract administration'**) (ranked 7th), and PDF 31 (**'Suspension of work by the owner'**).

Table 5.14: PDFs considered highly important by only PG PMs

PDF	PG ranking	PT ranking	PD ranking
29	3	32	36
33	4	12	15
32	5	14	13
57	6	17	43
30	7	16	11
34	7	30	19
31	9	46	42

PDF	C1	C2	Cause of delay
29	O	Exec	Delay in furnishing and delivering the site to the contractor by the owner
33	O	Exec	Slow decision making by the owner
32	O	Exec	Delay in issuance of change orders by the owner
57	E	MC	Delay in performing inspection and testing by the consultant engineer
30	O	Exec	Delay in the settlement of contractor claims by the owner
34	O	CCR	Uncooperative owner with the contractor complicating contract administration
31	O	SR	Suspension of work by the owner

PT PMs ranked only three PDFs 'highly important', while neither PG nor PD PMs ranked these as important (Table 5.15). These PDFs were PDF 38 (**'Owner's failure to coordinate with government authorities during planning'**) (ranked 8th), PDF 21 (**'No effective or realistic contingency plans in case the project is behind schedule or over budget'**) (ranked 9th) and PDF 19 (**'Improper technical study by the contractor during the bidding stage'**) (ranked 10th). PD PMs ranked two PDFs as 'highly important' while neither PG nor PT PMs ranked these as important (Table 5.16). These were PDF 40 (**'Changes in the project scope'**) and PDF 3 (**'Changes in materials prices'**). These PDFs were ranked 9th and 10th, respectively.

Table 5.15: PDFs considered highly important only by PT PMs

PDF	PG ranking	PT ranking	PD ranking
38	15	8	27
21	45	9	12
19	35	10	20

PDF	C1	C2	Cause of delay
38	O	Com	Owner's failure to coordinate with government authorities during planning
21	C	P	No effective or realistic contingency plans in case the project is behind schedule or over budget
19	C	P	Improper technical study by the contractor during the bidding stage

Table 5.16: PDFs considered highly important only by PD PMs

PDF	PG ranking	PT ranking	PD ranking
40	21	24	9
3	43	39	10

PDF	C1	C2	Cause of delay
40	O	P	Changes in the scope of project
3	ME	ME	Changes in materials prices

Agreement Level Test

Spearman Rank Correlation was applied to test for agreement between PMs towards the PDFs importance rankings, as described in section 4.5.2.2.5. Table 5.17 shows the agreement levels between PG, PT and PD PMs towards the importance rankings of all 58 PDFs. PT and PD PMs present a strong agreement level (rs = 0.75), which is significant at the 0.01 level. The strong agreement was expected since 25 PMs had worked on both PT and PD projects and, therefore, the PDF rankings of these PMs were considered the same. In other words, 25 responses out of both the 76 PT PM responses and out of the 44 PD PM responses were exactly the same (see column

PT, PD and (PT+PD) in Table 5.4). A response from a PM who experienced more than one project type will be replicated in all experienced project types.

Table 5.17: Spearman Rank Correlation applied to all 58 PDFs between Power Generation, Transmission and Distribution PMs

Project Manager Groups	Spearman rank correlation coefficient
PG-PT	.43**
PG-PD	.33**
PT-PD	.75**

** Significant at 0.01 level (1-tailed)

There is a moderate agreement between PG and PT PMs (rs = 0.43) towards the rankings of all 58 PDFs. There is also a weak agreement between PG and PD PMs (rs = 0.33). The agreement levels towards the rankings of the 21 ‘highly important’ PDFs are different than those presented in Table 5.17. Table 5.18 shows that the only significant Rank Correlation Coefficient is the one between PT and PD PMs. This moderate agreement (rs = 0.6) is significant at the 0.01 level. The agreement levels between PG-PT and PG-PD PMs were inconclusive since the coefficient results were not significant.

Table 5.18: Spearman Rank Correlation applied to the 21 highly important PDFs according Power Generation, Transmission and Distribution PMs

Project Manager Groups	Spearman rank correlation coefficient
PG-PT	-.30
PG-PD	-.32
PT-PD	.6**

** Significant at 0.01 level (1-tailed)

5.5 PDF Groups Ranking

It was stated in Chapter 4 that the PDFs considered in this study had various attributes. Those with common attributes could form a group of factors with meaningful and common characteristics. This study adopted two grouping approaches where the 58 PDFs were divided into several groups (see section 4.5.2.2.3 for more details). Evaluating the importance of these groups of PDFs provided some useful insights and conclusions.

5.5.1 Important PDF Groups – C1 grouping approach

The first PDF grouping approach (C1) classified PDFs based on the organisations responsible for causing these relevant PDFs. The importance ranking analysis was applied to these groups according to the SEC, Contractor and Consultant PMs. The most appealing results were those ranked by both the SEC and Consultant PMs (Table 5.19 and Table 5.21). The SEC PMs admitted that SEC-related PDFs were the most important ones in the investigated industry. However, it must be noted that the importance index was a function of both characteristics of **'Frequency of occurrence'** and **'Degree of severity**. The SEC PMs ranked their PDFs (i.e. caused by the SEC) highest in terms of **'Degree of severity'** (Table 5.19). In terms of **'Frequency of occurrence'**, on the other hand, the SEC-related PDF group was ranked 4^{th}. The combination of these two resulted in having an importance index with the highest value. This observation proved that both the **'Frequency of occurrence'** and **'Degree of severity'** features of a PDF were rated differently by the SEC PMs when other PM respondent groups tended to rate these features similarly.

Table 5.19: Ranking of PDF groups by the SEC PMs – C1 grouping approach

Sources (groups) of delay	Frequency of occurrence		Degree of severity		Importance index	
	Index	Rank	Index	Rank	Index	Rank
Material & Equipment factors	56.39	5	63.31	5	35.70	5
Manpower-related factors	58.14	1	64.96	4	37.77	2
Contractor-related factors	57.26	3	65.42	3	37.46	3
SEC-related factors	57.15	4	67.05	1	38.32	1
Consultant-related factors	55.63	6	66.56	2	37.02	4
External factors	57.36	2	58.66	6	33.65	6

Table 5.20: Ranking of PDF groups by the Contractor PMs – C1 grouping approach

Sources (groups) of delay	Frequency of occurrence		Degree of severity		Importance index	
	Index	Rank	Index	Rank	Index	Rank
Material & Equipment factors	53.36	6	64.29	5	34.30	5
Manpower-related factors	54.66	3	64.83	3	35.43	3
Contractor-related factors	54.09	4	64.39	4	34.83	4
SEC-related factors	57.75	2	66.27	2	38.27	2
Consultant-related factors	60.36	1	68.42	1	41.30	1
External factors	53.57	5	56.86	6	30.46	6

Table 5.21: Ranking of PDF groups by Consultant PMs – C1 grouping approach

Sources (groups) of delay	Frequency of occurrence		Degree of severity		Importance index	
	Index	Rank	Index	Rank	Index	Rank
Material & Equipment factors	65.99	4	68.71	3	45.34	3
Manpower-related factors	62.80	6	61.61	6	38.69	6
Contractor-related factors	64.92	5	64.57	5	41.91	5
SEC-related factors	71.06	1	72.69	1	51.65	1
Consultant-related factors	70.92	2	71.94	2	51.02	2
External factors	67.86	3	65.82	4	44.66	4

The other interesting result was that the Consultant PMs ranked the SEC-related PDFs highest followed by Consultant-related PDFs (Table 5.21). Contractor PMs, on the other hand, ranked Consultant-related highest followed by SEC-related PDFs (Table 5.20). Spearman Rank Correlation was then applied to examine the agreement levels between the three respondent PMs towards the importance rankings of these

PDF groups (Table 5.22). All coefficients were not significant and, therefore, the results were inconclusive.

Table 5.22: Spearman Rank Correlation applied to all 6 PDF groups – C1 grouping approach

Project Manager Groups	Spearman rank correlation coefficient
SEC-contractors	0.66
SEC-consultants	0.09
Contractors-consultants	0.43

A respondent group (i.e. the SEC, Contractor or Consultant PMs) may have agreed with another group to highly rank a PDF group. However, these two groups may have disagreed as to which PDFs belonging to this particular group were more or less important. Spearman Rank Correlation was applied for this purpose (see Table 5.23). Focusing on the significant coefficients, Table 5.23 shows that although both Contractor and Consultant PMs ranked the SEC-related PDFs as 'highly important' (ranked 2nd and 1st respectively), Spearman Rank Correlation coefficient reveals moderate disagreement between the PMs as to which of the PDFs within the SEC-related PDFs group were more important (rs = - 0.47).

Moreover, both Contractor and Consultant PMs ranked Material and Equipment PDFs 5th and 3rd respectively, while they strongly disagreed as to which of the PDFs within the Material and Equipment PDF group were more important (rs = -0.86). Both the SEC and Contractor PMs ranked the External PDFs group lowest (both ranked it 6th) and strongly agreed as to which of the PDFs within the External PDFs group were more important (rs = 0.86).

Table 5.23: Spearman Rank Correlation applied to PDFs groups – C1 grouping approach

Sources (groups) of delay	SEC-Contractor	SEC-Consultant	Contractor-Consultant
Material & Equipment factors	0.18	0.00	**-0.86****
Manpower-related factors	0.80	0.20	-0.40
Contractor-related factors	0.18	-0.24	-0.27
SEC-related factors	0.28	0.28	**(-0.47)**
Consultant-related factors	0.43	**-0.63**	-0.32
External factors	**0.86****	0.46	0.07

Note: **Significant at 0.01 level
( ) Significant at 0.05 level

5.5.2 Important PDF Groups – C2 grouping approach

PDFs were also classified regardless of which project key stakeholder organisation was responsible (C2). Importance ranking analysis was also applied to (C2) PDF groups according to the SEC, Contractor and Consultant PMs (Tables 5.24 – 5.26 respectively).

Table 5.24: Ranking of PDF groups by the SEC PMs – C2 grouping approach

Sources (groups) of delay	Frequency of occurrence		Degree of severity		Importance index	
	Index	Rank	Index	Rank	Index	Rank
Material & Equipment	56.39	7	63.31	9	35.82	7
Manpower	57.58	5	63.89	8	36.87	5
Communication processes	54.97	8	64.90	6	35.72	8
Planning processes	59.09	2	68.33	1	40.40	1
Executuion processes	58.00	3	65.15	5	37.78	4
Monitoring & Controlling processes	57.42	6	68.33	2	39.32	3
Financial delay causes	53.98	10	66.48	3	35.88	6
Stakeholder regulations	60.76	1	65.91	4	40.21	2
Contract/contractual relationship	54.17	9	64.58	7	34.95	9
External delay causes	57.58	4	57.58	10	33.32	10

Table 5.25: Ranking of PDF groups by the SEC PMs – C2 grouping approach

Sources (groups) of delay	Frequency of occurrence		Degree of severity		Importance index	
	Index	Rank	Index	Rank	Index	Rank
Material & Equipment	53.36	9	64.29	5	34.61	9
Manpower	54.17	8	65.60	4	35.87	6
Communication processes	54.74	6	63.78	8	34.90	8
Planning processes	55.20	5	69.31	1	38.43	2
Executuion processes	60.89	1	66.23	3	40.45	1
Monitoring & Controlling processes	54.41	7	64.22	6	35.09	7
Financial delay causes	57.48	2	64.22	6	36.98	4
Stakeholder regulations	57.06	3	63.63	9	36.81	5
Contract/contractual relationship	55.27	4	67.16	2	37.17	3
External delay causes	52.45	10	54.04	10	28.38	10

Table 5.26: Ranking of PDF groups by the SEC PMs – C2 grouping approach

Sources (groups) of delay	Frequency of occurrence		Degree of severity		Importance index	
	Index	Rank	Index	Rank	Index	Rank
Material & Equipment	65.99	8	68.71	4	45.46	6
Manpower	64.09	10	62.50	10	40.24	10
Communication processes	70.63	2	71.83	1	51.20	1
Planning processes	65.95	9	67.62	7	44.80	7
Executuion processes	67.06	6	68.65	5	46.21	5
Monitoring & Controlling processes	66.19	7	66.90	8	44.50	8
Financial delay causes	70.54	3	69.94	2	49.40	2
Stakeholder regulations	70.95	1	69.29	3	49.31	3
Contract/contractual relationship	68.15	4	68.45	6	46.66	4
External delay causes	67.26	5	64.88	9	43.65	9

The first observation was that the Planning processes-related PDFs group was ranked highest by the SEC PMs, 2^{nd} by Contractor PMs and 7^{th} by Consultant PMs. The second observation was that the Execution processes-related PDFs group was ranked 4^{th} by the SEC PMs, 1^{st} by Contractor PMs and 5^{th} by Consultant PMs. Consultant PMs, unlike the other two, ranked the Communication PDFs group highest, while the SEC and Contractor PMs both ranked this PDFs group 8^{th}. Spearman Rank Correlation was applied to examine the agreement levels between the three respondent PMs towards the importance rankings of these PDF groups (Table 5.27). All coefficients were not significant and, therefore, the results were inconclusive.

Table 5.27: Spearman Rank Correlation applied to all 10 PDF groups – C2 grouping approach

Project Manager Groups	Spearman rank correlation coefficient
SEC-contractors	0.52
SEC-consultants	-0.1
Contractors-consultants	0.24

As was previously observed in section 5.5.1, individuals within a respondent group may have agreed with another group to highly rank a PDF group, but these two groups may have disagreed as to which PDFs belonging to this particular group were more or less important. Spearman Rank Correlation was applied for this purpose (see Table 5.28). For example, Table 5.28 shows that Spearman Rank Correlation coefficients present moderate to strong agreement levels towards the rankings of PDFs within the Communication-related group. This is despite the fact that PMs ranked the Communication PDF group differently. Both the SEC and Contractor PMs ranked the Communication PDF group 8th, while Consultant PMs ranked it as the most important group.

Table 5.28: Spearman Rank Correlation applied to PDFs groups – C2 grouping approach

Sources (groups) of delay	SEC-Contractor	SEC-Consultant	Contractor-Consultant
Material & Equipment factors	0.18	0.00	**-0.86****
Manpower-related factors	**0.71**	0.14	0.20
Communication processes	**(0.65)**	**0.78****	**(0.58)**
Planning processes	-0.20	-0.56	-0.67
Execution processes	0.14	0.03	0.43
Monitoring & Controlling processes	0.40	-0.60	0.20
Financial delay causes	**(0.95)**	-0.63	-0.40
Stakeholder regulations	**1****	0.30	0.30
Contract/contractual relationship	-0.20	**0.80**	-0.40
External delay causes	**1****	0.40	0.40

Note: **Significant at p<0.01
( ) Significant at p<0.05

In the search for the Project Implementation Challenges Model in the Saudi Arabian electricity industry, this chapter applied some numerical analysis to the 58 surveyed PDFs. After describing the research participants' profiles, the analysis focused on identifying the highly ranked PDFs as perceived by the SEC, Contractor and Consultant PMs. Highly ranked PDFs were those with the highest 10 importance index values according to any of the three participant groups. Collectively, there were 22 highly ranked PDFs as perceived by the SEC, Contractor and Consultant PMs. This procedure was repeated with PG, PT and PD PMs, and collectively there were 21 highly ranked PDFs.

Spearman Rank Correlation tests were applied to both sets of respondent groups (i.e. the SEC, Contractor and Consultant and PG, PT and PD PMs) to test for the agreement levels between these groups towards the PDFs rankings. As for the first set of respondent groups, the only significant result was the agreement level between the SEC and Contractor PMs towards the rankings of the 58 PDFs. There was a moderate agreement with a coefficient value of rs = 0.48. Having a moderate agreement indicates that there was, to a certain degree, a shared perception between the SEC and Contractor PMs as to which of the PDFs were more important. The remaining Spearman Rank Correlation coefficients were not significant to incur any conclusions.

A Spearman Rank Correlation test was also applied to PG, PT and PD PMs towards the PDFs rankings. When applied to the rankings of the 58 PDFs, the agreement levels ranged from moderate to strong agreements between the PMs. PT and PD PMs showed a strong agreement (rs = 0.75), PG and PT PMs showed moderate agreement (rs = 0.43) and, finally, PG and PD PMs showed weak agreement (rs = 0.33) towards the rankings of the 58 PDFs. These agreement levels indicated varying degrees of shared perceptions between PG, PT and PD PMs as to which PDFs were more important. When Spearman Rank Correlation was applied to the 21 highly ranked PDFs, the only significant result was the one between PT and PD PMs. The remaining coefficients were not significant to incur any conclusions. One reason for having non-significant coefficients was because the sample size of the ranked PDFs was downsized from 58 to 21. However, having a significant coefficient between the PT and PD PMs was because approximately one third of the PT PMs responses (25 out of 76 PT PMs responses) and over half of the PD PMs responses (25 out of 44 PD PMs responses) were exactly the same. Therefore, the importance rankings of the PDFs between the two groups were closer to each other.

Importance Ranking Analysis was also applied to the PDFs groups as perceived by the SEC, Contractor and Consultant PMs. The most apparent results were those relevant to organisational responsibility PDF groups. Both the SEC and the Consultant PMs ranked the SEC-related PDFs group highest. The Consultant PMs ranked Consultant-related PDFs group the next most important right after the SEC-related PDFs group. The Contractor PMs agreed, to a great extent, with the other two groups of PMs. These ranked the Consultant-related PDFs and the SEC-related PDFs groups the most important PDF groups (ranked 1st and 2nd respectively). This showed that the respondent groups were, in general, not biased when ranking the PDFs.

It is acknowledged that both importance ranking analysis and Spearman Rank Correlation did not reveal a great deal about how the respondent groups perceived the PDFs. Many factors contributed to the limitations of these tests. In the questionnaire survey, a PDF broadly indicated a specific event, circumstance, force, or constraint that contributed to project delay. In reality, however, a PDF was far more complex than the given description in the survey. One source of complexity was the interdependencies that existed between several PDFs, making it even more challenging to capture their dynamic interactions. This challenge became more apparent when the research attempted to group these PDFs based on an objective measure. Grouping these PDFs, however, was based on subjective measures using two different grouping approaches (C1 and C2).

5.6 Factor Analysis – Selection of the Most Important PDFs

One of the Ranking Analysis outcomes applied to the PDF groups was that the respondent groups (the SEC, Contractor and Consultant PMs) presented non-biased perceptions. This was evident when all three PM groups ranked the SEC-related and Consultant-related PDFs highest, although over half of the sample were PMs from the SEC and Consultant organisations (33 PMs represented the SEC, 21 represented Consultants and 51 represented Contractors). However, there were other outcomes from the conducted analyses which needed further investigation. For example, both the SEC and Contractor PMs ranked PDF 46 (**'Owner's tendering system requirement of selecting the lowest bidder'**) highest, while this PDF was not even among Consultant PMs' top 10 PDFs. Instead, Consultant PMs ranked the Communication-related PDFs group highest when compared to the SEC and Contractor PMs. This example, along with others, shows that ranking analyses and Spearman Rank Correlation Coefficients were not able to provide a comprehensive outlook explaining these differences. It must be noted, though, that the nature of these PDFs is highly complex and one form of complexity is the interrelationships between these PDFs, as will be discussed in this chapter. This fact, however, will be used to the advantage of the research since the researcher has first selected the most important PDFs for further analyses.

The most important PDFs are those highly ranked by any of the respondent groups (the SEC, Contractor, Consultant, Power Generation, Power Transmission and Power Distribution Project Managers). The SEC, Contractor and Consultant PMs highly ranked 22 PDFs, while the PG, PT and PD PMs highly ranked 21 PDFs. Most of these PDFs were common between the two sets of respondent groups. Uncommon PDFs are presented in Tables 5.29 and Table 5.30, respectively. Collectively, all highly ranked and, hence, the most important PDFs, as perceived by all the PMs, amounted to 28 PDFs and were selected for Factor Analysis, as described earlier (Table 5.31). Factor Analysis was used to explore the structure of the correlations among these most important PDFs. The structure of these correlations will produce a meaningful set of components. These components will eventually construct the Project Implementation Challenges (PICs) conceptual model. The significance of these PICs is in their being composed from the 28 most important PDFs identified by all PMs who participated in this study.

Table 5.29: List of the highly ranked PDFs according to the SEC, Contractor and Consultant PMs but not by PG, PT or PD PMs

PDF No.	C1	C2	Cause of delay
PDF 9	M	M	Low skill of manpower
PDF 23	C	MC	Ineffective control of the project's progress by the contractor
PDF 26	C	Fin	Difficulties in financing the project by the contractor
PDF 29	O	Exec	Delay in furnishing and delivering the site to the contractor by the owner
PDF 36	O	Com	Owner's poor communication with related government authorities
PDF 37	O	Com	Owner's poor communication with contractors and consultants during project execution
PDF 39	O	Com	Poor coordination by the owner with the various parties during project execution
PDF 55	E	Com	Poor communication between the consultant engineer and other parties involved

Table 5.30: List of the highly ranked PDFs according to PG, PT and PD PMs but not by the SEC, Contractor or Consultant PMs

PDF No.	C1	C2	Cause of delay
PDF 3	ME	ME	Changes in materials prices
PDF 19	C	P	Improper technical study by the contractor during the bidding stage
PDF 29	O	Exec	Delay in furnishing and delivering the site to the contractor by the owner
PDF 31	O	SR	Suspension of work by the owner
PDF 32	O	Exec	Delay in issuance of change orders by the owner
PDF 34	O	CCR	Uncooperative owner with the contractor complicating contract administration
PDF 40	O	P	Changes in the scope of project

Table 5.31: Most important PDFs according to the SEC, Contractor, Consultant, Power Generation, Power Transmission and Power Distribution PMs – (28 PDFs)

No.	Project Delay Factor Description
PDF 2	Delay in materials delivery
PDF 3	Changes in materials prices
PDF 8	Shortage of manpower
PDF 9	Low skill of manpower
PDF 19	Improper technical study by the contractor during the bidding stage
PDF 20	Ineffective planning and scheduling of the project by the contractor
PDF 21	No effective or realistic contingency plans in case the project is behind schedule or over budget
PDF 23	Ineffective control of the project's progress by the contractor
PDF 26	Difficulties in financing the project by the contractor
PDF 29	Delay in furnishing and delivering the site to the contractor by the owner
PDF 30	Delay in the settlement of contractor claims by the owner
PDF 31	Suspension of work by the owner
PDF 32	Delay in issuance of change orders by the owner
PDF 33	Slow decision making by the owner
PDF 34	Uncooperative owner with the contractor complicating contract administration
PDF 35	Delay in progress payments by the owner
PDF 36	Owner’s poor communication with related government authorities
PDF 37	Owner’s poor communication with contractors and consultants during project execution
PDF 38	Owner’s failure to coordinate with government authorities during planning
PDF 39	Poor coordination by the owner with the various parties during project execution
PDF 40	Changes in the scope of project
PDF 41	Ambiguities, mistakes and inconsistencies in specifications and drawings
PDF 45	Difficulties in obtaining work permits
PDF 46	Owner's tendering system requirement of selecting the lowest bidder
PDF 54	Delay in the approval of contractor submissions by the engineer
PDF 55	Poor communication between the consultant engineer and other parties involved
PDF 57	Delay in performing inspection and testing by the consultant engineer
PDF 58	Slow response from the consultant engineer to contractor inquiries

5.6.1 Sampling adequacy test

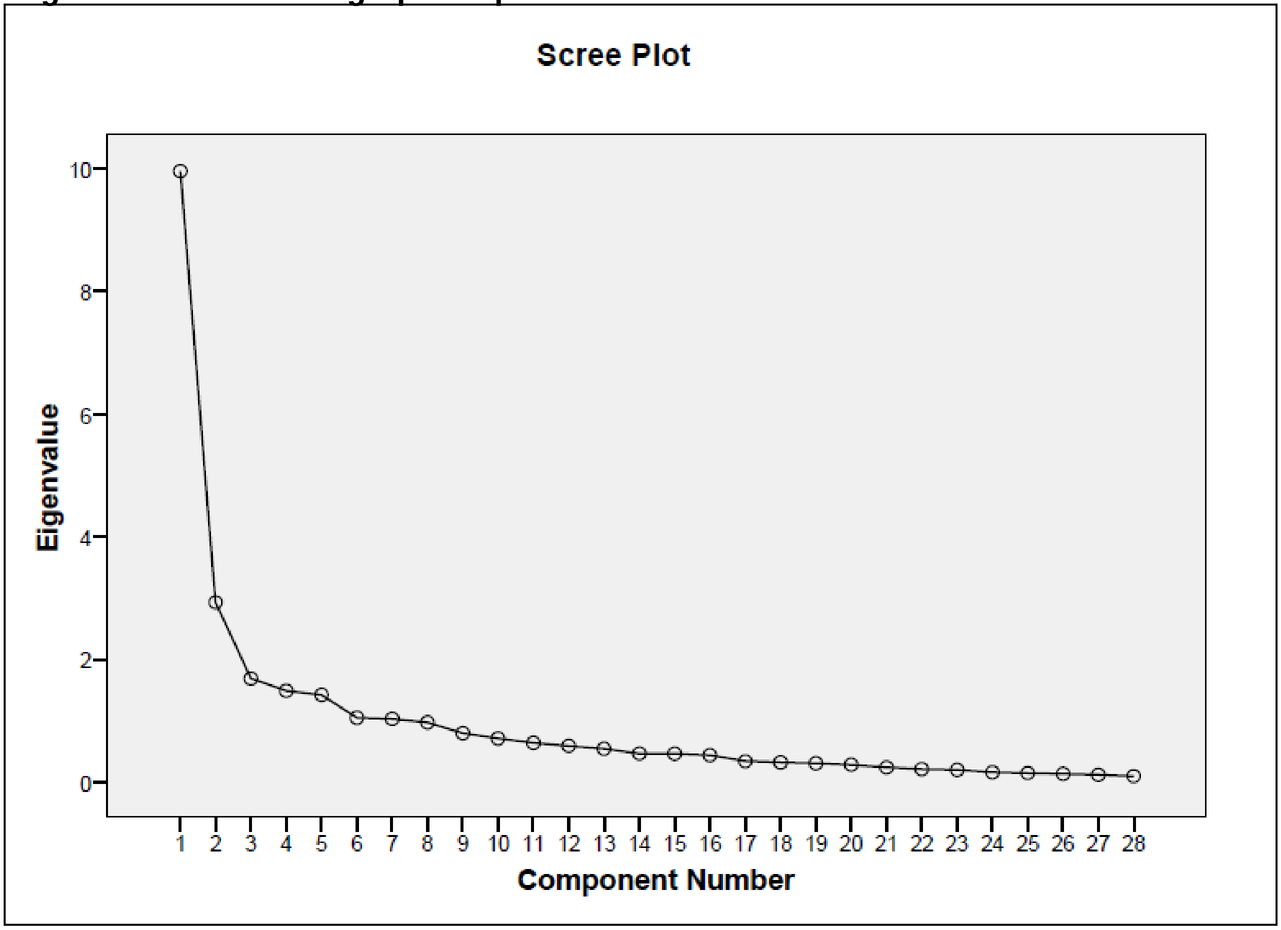
Factor analysis was run using SPSS v.15. Detailed steps for running the analysis using SPSS are described by Field (2009). The value of the Kaiser-Meyer-Oklin (KMO) sampling adequacy statistic was 0.857, which was satisfactorily good for the analysis. The Bartlett’s test of sphericity equalled 1730 and the associated significance level was ($p = 0.001 < 0.05$). Therefore, the data were suitable for Factor Analysis to be conducted.

5.6.2 Factor (components) extraction

Eigenvalues and Scree Plot analyses were conducted to extract and determine the set of components that will consist of the 28 most important PDFs. The maximum possible number of components could be the same number as the selected PDFs, which is 28. However, it is desirable to retain components that consisted of all 28 PDFs with the least number of components as possible. A Kaiser's test, otherwise known as the eigenvalue rule, and a Scree Plot test were used to determine these 'principal' components.

The Scree Plot test involved plotting each of the components' eigenvalue and testing for the point of inflexion (Figure 5.1). The point of inflexion is where the slope of the line changed dramatically to become horizontal. The components on the left of the inflexion point are with highest eigenvalues that shall be retained (without including the inflexion point itself) (see section 4.5.2.2.6). The Plot, however, is ambiguous since it shows two different inflexion points that occurred at the third and the fifth components. The curve began to tail off after two components but there was another drop after the fifth component before a horizontal line is converged. This graph then suggests extracting (retaining) either two or four components.

Figure 5.1: Scree Plot graph output



Using the eigenvalue rule of the Kaiser's test is a more straightforward process where the number of components necessary to represent the examined variables (the 28 most important PDFs) was selected for components with eigenvalues of 1.0 or more. Seven components had eigenvalues over the Kaiser's criterion and in combination these components explained 70.05% of the variance (Table 5.32). Therefore, it was decided to proceed further with the analysis using the Kaiser's test result where a definite number of the retained components was determined rather than the ambiguous Scree Plot.

Table 5.32: Initial eigenvalues of the Factor Analysis Principal Components

Component	Initial eigenvalues		
	Total	Variance (%)	Cumulative (%)
1	9.957	35.562	35.562
2	2.937	10.488	46.051
3	1.696	6.055	52.106
4	1.498	5.348	57.455
5	1.430	5.106	62.561
6	1.058	3.777	66.338
7	1.039	3.712	70.050
8	0.981	3.502	73.552
9	0.805	2.877	76.429
10	0.721	2.576	79.005
11	0.648	2.315	81.320
12	0.601	2.145	83.465
13	0.553	1.976	85.441
14	0.475	1.697	87.138
15	0.472	1.684	88.823
16	0.447	1.596	90.418
17	0.351	1.253	91.671
18	0.331	1.184	92.855
19	0.316	1.128	93.983
20	0.293	1.046	95.029
21	0.249	0.891	95.920
22	0.222	0.792	96.712
23	0.210	0.752	97.463
24	0.170	0.607	98.071
25	0.158	0.565	98.636
26	0.144	0.515	99.150
27	0.130	0.465	99.615
28	0.108	0.385	100.000

5.6.3 Varimax orthogonal rotation

The initial few components relatively explained the large amount of variance (especially component number 1), whereas the subsequent components explained only a small amount of variance. Rotating the component matrix optimised the components' structure in which the relative significance of the extracted components (i.e. with eigenvalues over or equal to 1.0 as per the Kaiser's criterion) was spread over the components. Varimax orthogonal rotation is the most common rotation method and was used for the purposes of this research. Before rotation, component 1 accounted for considerably more variance that the remaining six (i.e. 35.5% compared to 10.49%, 6.06%, 5.35%, 5.11%, 3.78% and 3.71% respectively). After applying Varimax rotation, the relative significance was optimised and rearranged over these components. The first component now accounted for 17.58% of variance compared to 12.88%, 11.81%, 11.20%, 6.56%, 5.01% and 5.01% for components 2-7 respectively (Table 5.33).

Table 5.33: Initial eigenvalue of the retained Principal Components and eigenvalues after applying Varimax orthogonal rotation

Component	Initial eigenvalues			Rotation sums of square loadings		
	Total	Variance (%)	Cumulative (%)	Total	Variance (%)	Cumulative (%)
1	9.957	35.562	35.562	4.921	17.575	17.575
2	2.937	10.488	46.051	3.608	12.884	30.459
3	1.696	6.055	52.106	3.308	11.814	42.273
4	1.498	5.348	57.455	3.136	11.202	53.474
5	1.430	5.106	62.561	1.837	6.561	60.036
6	1.058	3.777	66.338	1.402	5.009	65.044
7	1.039	3.712	70.050	1.402	5.005	70.050

5.6.4 Factor loadings

The PDFs, in which were found the elements that made up the 7 retained principal components, contributed variably to each of these components. The gauge of which of the PDFs describes its contribution level to its principal component is called the ‘Loading Factor’. The higher the Loading Factor value of a PDF the more it contributes to the retained principal component. The Loading Factor represents the statistical significance of a correlation coefficient between the PDF (as an element) and its corresponding principal component. The minimum significance level of a factor loading depends on the sample size. The minimum loading value where it is considered significant for this study's sample size (105 participants) was 0.512 (Field, 2009). However, when using SPSS to set the Loading Factor at 0.512, three PDFs (out of the 28 PDFs) were presented without Loading Factor values. This indicated that these three PDFs made an insignificant contribution to their corresponding components. These PDFs were PDF 26 (**'Difficulties in financing the project by the contractor'**) in component 1, PDF 45 (**'Difficulties in obtaining work permits'**) in component 2 and PDF 40 (**'Changes in project scope'**) in component 7. For the purpose of knowing the Loading Factor values of these 'non-significant' PDFs, Factor Analysis was conducted repeatedly with Factor Loading values settings of less than 0.512. The procedure was done repeatedly until all PDFs appeared with Factor Loading values; the lowest value was (0.482) for PDF40 (**'Changes in project scope'**) (Table 5.34).

Table 5.34: The Loading Factor values of the 28 most important PDFs within the 7 Principal Components

PDF	No.	PDF Description	Component 1	2	3	4	5	6	7
PDF	35	Delay in progress payments by the owner	0.757						
PDF	30	Delay in the settlement of contractor claims by SEC	0.719						
PDF	34	Uncooperative owner with the contractor complicating contract administration	0.717						
PDF	31	Suspension of work by the owner	0.698						
PDF	29	Delay in furnishing and delivering the site to the contractor by SEC	0.641						
PDF	32	Delay in issuance of change order by SEC	0.637						
PDF	33	Slow decision making by SEC	0.574						
PDF	26	Difficulties in financing the project by the contractor	0.505*						
PDF	38	SEC's failure to coordinate with government authorities during planning		0.801					
PDF	36	SEC's poor communication with related government		0.754					
PDF	37	SEC's poor communication with contractors and consultants during project execution		0.616					
PDF	39	Poor coordination by SEC with the various parties during project execution		0.591					
PDF	45	Difficulties in obtaining work permits		0.485*					
PDF	21	No effective or realistic contingency plans in case the project is behind schedule or over budget			0.795				
PDF	20	Ineffective planning and scheduling of the project by the contractor			0.772				
PDF	23	Ineffective control of the project's progress by the contractor			0.757				
PDF	19	Improper technical study by the contractor during the bidding stage			0.607				
PDF	2	Delay in materials delivery			0.552				
PDF	54	Delay in the approval of contractor submissions by the engineer				0.763			
PDF	58	Slow response from the consultant engineer to contractor inquiries				0.727			
PDF	57	Delay in performing inspection and testing by the consultant engineer				0.639			
PDF	55	Poor communication between the consultant engineer and other parties involved				0.547			
PDF	9	Low skills of manpower					0.794		
PDF	3	Changes in material prices					0.577		
PDF	8	Shortage of manpower					0.524		
PDF	46	SEC's tendering system requirement of selecting the lowest bidder						0.809	
PDF	41	Ambiguities, mistakes and inconsistencies in specifications and drawings							0.629
PDF	40	Changes in project scope							0.482*

* Non-significant Loading Factor

5.6.5 Describing the Project Implementation Challenges

In this research context, the retained principal components are the Project Implementation Challenges the study aimed to identify. Having identified the Project Implementation Challenges (principal components) which comprised the most important PDFs identified by the SEC, Contractor, Consultant, PG, PT and PD PMs in the investigated industry, the next step was to suggest names that described these principal components. The names should communicate the nature of the underlying construct by looking for patterns of similarity between PDFs that load on a component (Shehu and Akintoye, 2010). Table 5.35 below presents the suggested names of the Principal Components after considering the nature of the contributing PDFs with significant loading factors.

Table 5.35: Suggested titles for the Project Implementation Challenges

No.	Component	PDF description
1	SEC's Contractual Commitment	Delay in progress payments by the owner Delay in the settlement of contractor claims by the owner Uncooperative owner with the contractor complicating contract administration Suspension of work by the owner Delay in furnishing and delivering the site to the contractor by the owner Delay in issuance of change order by the owner Slow decision making by the owner (Difficulties in financing the project by the contractor)
2	SEC's Communication and Coordination Effectiveness	Owner's failure to coordinate with government authorities during planning Owner's poor communication with related government Owner's poor communication with contractors and consultants during project execution Poor coordination by the owner with the various parties during project execution (Difficulties in obtaining work permits)
3	Contractor's Project Planning and Controlling Effectiveness	No effective or realistic contingency plans in case the project is behind schedule or over budget Ineffective planning and scheduling of the project by the contractor Ineffective control of the project's progress by the contractor Improper technical study by the contractor during the bidding stage Delay in materials delivery
4	Consultant-related	Delay in the approval of contractor submissions by the engineer Slow response from the consultant engineer to contractor inquiries Delay in performing inspection and testing by the consultant engineer Poor communication between the consultant engineer and other parties involved
5	Manpower Challenges & Materials Uncertainty	Low skills of manpower Changes in material prices Shortage of manpower
6	SEC's Tendering System	SEC's tendering system requirement of selecting the lowest bidder
7	Lack of Project Requirements Clarity	Ambiguities, mistakes and inconsistencies in specifications and drawings (Changes in project scope)

( ) PDFs with non-significant Loading factor value (<0.512)

6. Project Implementation Challenges – Conceptual Model

6.1 Introduction

Ranking analyses were applied to all 58 surveyed PDFs in the previous chapter. These were followed by applying Factor Analysis to the 28 highly ranked PDFs. This chapter seeks to develop a conceptual model that provides more in-depth insights about the 7 Principal Components constructed with the 28 highly ranked PDFs by presenting supporting qualitative data. Before presenting the conceptual model of the Project Implementation Challenges the study aimed to explore, an introduction of what constitutes conceptual modelling is presented.

6.2 Conceptual Model Development

Modelling is the process of developing an analogical system of relations between variables and entities (Willemain, 1995), and the resulting model is the structure that exhibits the features and characteristics of certain scenarios (Sen and Vinze, 1997). Modelling enables researchers to draw in-depth judgements about particular situations. If these situations remained without modelling, they are frequently left implicit and unquestioned (Wilson, 2001). Constructing models enhances the understanding of the scenario being modelled in addition to providing a better management of the scenario's complexities (Yoon, 2010; Williams, 1990).

One of the most popular types of modelling is conceptual modelling. Conceptual modelling is a theoretical approach that simplifies the management of data (Parent, 2006) whereby the patterns of meanings and concepts are captured (Solomon, 1988). A conceptual model has well-defined elements where the relationships between variables are continuously evolving, allowing more in-depth understanding of the modelled situations, scenarios or problems (Williamson, 1997). In addition to the robust theoretical basis it offers for this particular research, the formulation of the conceptual model has several advantages, including the following:

- It provides a holistic and simplified view of the project implementation challenges from a complex perspective
- It enhances the understanding of the interaction between the principal components (Project Implementation Challenges) and the highly ranked project delay factors identified in the previous chapter
- It presents a clarification of the roles of all highly ranked project delay factor elements and their contribution to their principal components
- It provides a reliable construct for the key project stakeholders that prioritises which of these challenges are of their concern.

6.3 SEC's Contractual Commitment

All stakeholders were interested in delivering the SEC's projects on time. The range of interest, however, depended on the varying degree of involvement and stakes in these projects. Example stakeholders were the SEC, Contractors, Consultants, manufacturers, suppliers, the government, and various end-users. Those who were involved on a daily basis with the SEC projects during construction were the SEC Project Execution Department, Contractors and Consultants. These three represented different organisations with the mutual objective of turning a project concept into a real operating product. Apart from this mutual project objective, the SEC and Contractors had a conflict of interest over objectives. The Contractors sought to maximise their profits while the SEC strived to have the best value for money projects.

Consultants were outsourced to protect the SEC's project interests, ensuring the Contractor's adherence as per the SEC's technical requirements. Therefore, a coherent binding contract that documented the terms and conditions in which both the SEC and Contractors were bound was necessary to avoid or manage conflicts when they arose. The contract was intended to be used as a guide to govern the SEC and Contractor's respective rights, duties and obligations for project performance.

This first Principal Component of the Project Implementation Challenges (i.e. the SEC's Contractual Commitment) accounted for 17.58% of total variance explained and consisted of 8 PDFs. All PDFs (except for the last PDF) were concerned with the SEC contractual obligations and duties as shown in Table 8.8. Each of the PDFs under this Principal Component will be discussed in turn. Qualitative data will be presented in the form of direct quotes and verbatim in a flow that provides in-depth insights. These insights will build the conceptual model uncovering the details of the Project Implementation Challenges. The names given to the participants whose direct quotes will be presented is consistent with Table 6.1.

Table 6.1: SEC's Contractual Commitment PDFs

PDF	LF	PDF Description
35	0.757	Delay in progress payments by the owner
30	0.719	Delay in the settlement of contractor claims by the owner
34	0.717	Uncooperative owner with the contractor complicating contract administration
31	0.698	Suspension of work by the owner
29	0.641	Delay in furnishing and delivering the site to the contractor by the owner
32	0.637	Delay in issuance of change order by the owner
33	0.574	Slow decision making by the owner
26	0.505*	Difficulties in financing the project by the contractor

PDF: Project Delay Factor
LF: Loading Factor value
* Non-significant Loading Factor

6.3.1 PDF 35 ('Delay in progress payments by the SEC')

Any delay in progressing a Contractor's payment was associated with the risk of disrupting project work flow in many aspects. In addition to his manpower, who expected to have their payments and salaries due in a timely manner, the Contractor was financially committed to different manufacturers, suppliers, and subcontractors. Therefore, it was not a surprise to find this PDF among the Contractor's highly ranked PDFs (ranked 8th). Not being highly ranked by both the SEC and the Consultant PMs was reasoned by their not being as directly affected as the Contractors. Although this PDF had varying effects depending on the project size and the Contractor's financial circumstances, it had the highest Loading Factor in this principal component of "SEC's Contractual Commitment" (Sig.=0.757).

After forming the SEC in 2000, one noticeable reform was no longer allowing it to authorise any project without allocating the required funds. The Executive Vice President of the SEC (Western Operating Area) admitted (in a conversation rather than a recorded interview) that this particular PDF was a major contributor and had a significant impact on SEC project delivery progress. This showed this PDF is still persistent, although it was worse before the SEC began operation in 2000. At present, the challenge is in managing the SEC's cash-flow in a convenient manner. Besides the contractual commitments with its Contractors and loan providers, the SEC has highly intensive operational and maintenance costs around the whole Kingdom. Therefore, processing the payments of several Contractors in a short period is a concern for the SEC Finance Department. SAF (SEC) gave an example of this particular PDF:

> Once, many Contractors demanded 3-4 billion Saudi Riyals in one month. We received an invoice for 1100 million and another for 200-300 million etc. which made it difficult to manage the amount due in a short time.

Moreover, several SEC PMs mentioned that Contractors usually filled in the relevant forms with errors and this added to the delay. Approving these forms and accepting the attached invoices was not an undisturbed process. Some Contractors, for example, claimed for non-completed milestones when they should not have done so. Processing the invoices and relevant documents required a careful check by an SEC PM to approve who needed to state the technical deliverables and match these with the Contractor's claim and actual achievements.

Then, there was the journey of securing the relevant signatures before the payment was processed. The higher the invoice value the more signatures were required in order to release the payment.

GARA (Contractor) described to what extent processing of the payment could be delayed:

> They waste our efforts by making us follow and track the progress of the invoice. When we asked the project management department where the invoice stands, they told us to check with the Finance Department. We are supposed to have one focal point to deal with and this is the Project Manager [of SEC]. I am not supposed to deal with anyone else. He must solve these problems himself. But with SEC you deal with the PM, with the civil engineer, and with any department you require approval from. You deal with the secretary and follow-up with him as to whether or not he forwarded the submittals, and you deal with the Finance Department and whether they reviewed the invoice and forwarded it for other approvals or just ignored it.

6.3.2 PDF 30 ('Delay in the settlement of Contractor claims by the SEC')

According to the SEC Contracting Manual, a 'Claim' is defined as "any written notice made by the SEC or by a Contractor to obtain monetary recovery (or time extension to the contract) from the other party after an attempt to resolve a dispute amicably has failed". This PDF was concerned with claims issued by Contractors to the SEC and it referred to the late decision taken by the SEC with any Contractor compensation demands as a result of project work variations. This PDF represented the second highest loading of the 'SEC Contractual Commitment' principal component (Sig. =0.719). Although the 'Claim' definition implied a tense confrontational attitude between the Contractors and the SEC, it was, however, perceived as a very common action.

Project work variations were inevitable and these were mostly associated with requiring additional time and extra costs resulting from the Contractor's prolonged presence on site, or procuring project items that were not agreed in the contract but yet requested by the SEC. Work variations which caused project delays were diverse and could be attributed according to responsibility either to the SEC, to Consultant engineers or to external forces. Therefore, the timely settlement of these claims was crucial for sustaining project progress and maintaining a healthy relationship between project parties. Any settlement must ensure fair outcomes and achieve a common understanding between all parties. Otherwise, prolonged settlement of the Contractor's claims would lead to contractual disputes or, at the very least, to unwanted opportunistic behaviour by the Contractor throughout the project execution. This PDF was, therefore, highly ranked by only Contractor PMs (ranked 10th) since its impact affected their organisational interests, especially when these claims were justified.

The general attitude of the SEC towards Contractor claims was best described by ORFA (SEC):

> The Contractor mostly thinks he can fool us (SEC). For example, he claims that we are liable to pay for his manpower because we delayed him for not having the project site ready to initiate his work. We mostly reject such non-justifiable claims. But most of the Contractors, especially the large ones like Siemens and ABB, give it a try and ask for financial compensation costs through these claims whether they will be settled or not.

Consultant engineers also played a key role for Contractors claiming for time-extension. This explained why Contractor PMs ranked Consultant-related PDFs highest. SAR (SEC) explicitly pointed out that Consultant engineers were a delay factor in SEC projects when asked for evidence to support his claim:

> Because of the claims we get from them (Contractors) when we intend to apply delay

> penalties. They manage to prove that during the design review the Consultants approved their drawings late.

In this case, the Contractor could at least escape from the penalty delay and secure a time-extension approval to deliver the project, but definitely without direct financial compensation. SAF (SEC) thought that Contractors had their own methods to claim for time-extension by, for example, arranging for many inspections at the same time:

> They do that sometimes to blame the Consultants for the delay. They have their own tricks (laughs) although the Contractors themselves are not ready for the inspection. They give us the inspection notification while we (SEC and Consultant engineers) are busy with other work in order to claim for time-extension.

6.3.3 PDF 34 ('Uncooperative owner with the Contractor complicating contract administration')

This PDF meant that SEC representatives were unhelpful and unsupportive, impeding steady project progress whether intentionally or otherwise. This factor was with the third highest loading of the SEC Contractual Commitment principal component (Sig. =0.717). In turnkey projects, SEC contracts with Contractors were developing and subject to change and amendment even after project award. In many cases, the contract had clauses that were neither explicit nor clear. As a consequence, the SEC PM would naturally have interpreted these clauses in a way that would have served the interests of his employer organisation:

> Well if there were grey areas it doesn't make any sense to interpret these for the Contractor's interests. We (SEC) will interpret these for our interests and he would interpret these for his own interests. So, there are sometimes disagreements in this matter. And sometimes it (the contract) is clear enough but still (laughs) he insists on misinterpreting the clauses.

There were cases when the researcher felt that not settling justified Contractor claims was common in SEC projects. When ORFA (SEC) was specifically asked whether he thought that some of the change orders claimed by Contractors were justified, he replied:

> Some of them, yes. But not all of them!
>
> Researcher: Do you cooperate with them and settle these justified ones?
>
> ORFA: As I told you, we mostly do not accept change orders.

A different attitude by WALA (SEC) towards his organisation's contractual behaviour with Contractors was noticed:

> SEC asks for additional spare parts or even equipment while the Contractor expects the contract to be read thoroughly and hence honoured.

GARA (Contractor) elaborated on this issue with frustration:

> SEC doesn't want to pay any additional cost. They want everything for free. If they wanted something urgently –an additional item that was beyond the contract - they threaten us using previous mistakes or delays we made in other parts of the project or would apply a penalty or push us backwards (by delaying an important approval) if we didn't fulfil their (non-contractual) demands.

The above statement was narrated by a PM who worked for an international Contractor that had a sound presence in the Saudi electricity Contracting market. This indicated that such uncooperative behaviour would have an even greater impact on smaller Contractors who would feel more vulnerable if they stood up against SEC wants and desires. ORFA PM (SEC) stated:

> We (SEC) usually receive claims from Corporate (large) Contractors. The smaller ones try their best to please us.

6.3.4 PDF 31 ('Suspension of work by the SEC')

This PDF referred to the interruption of project activities as a result of different forces. After awarding the project contract to the winner bidder, the actual project execution could be severely affected and delayed, as will be explained below. This PDF represented the fourth highest loading factor value which contributed to the 'SEC Contractual Commitment' principal component (Sig. =0.698) and was ranked 9th by PG PMs.

Suspension of project work could be relatively temporary (for a few months) as a result of, for example, the work site not being ready to handover to the Contractor. This can result, for example, from the necessary paperwork and permits not being issued by the relevant authorities. There were other extreme cases where projects were completely suspended as a consequence of, what would be seen as, external forces. JAWI SEC PM stated:

> One of my colleagues had a project in Makkah which was awarded to a contractor and when they started execution, the Transportation Ministry (public motorways owner) suspended the project as they had other project plans. Such problems are out of our (SEC) control. Even if we secured the required project work approvals, after having these approvals the authorities could stop us.

The above example showed an obvious lack of strategic planning coordination between public service authorities and the SEC. This observation was noticed in several project cases and, as a result, the SEC had to relocate many of its projects. ORFA (SEC) gave another example of when a Contractor initiated the project work to build a new substation in a high-profile urban area whose residents managed to rally and complain against the SEC and o prevented it from constructing the substation. Their concern was relevant to the potential harm the high-voltage transformers could cause their health in the long-term. The project was completely suspended. At least four other similar projects were reported suspended for the very same reason.

6.3.5 PDF 29 ('Delay in furnishing and delivering the site to the Contractor by the SEC')

This PDF referred to the late project site handover to the Contractor after the project award. As a result, this delayed mobilising his equipment, materials and manpower to initiate the project work. This PDF came with the fifth highest loading factor for the 'SEC Contractual Commitment' principal component (Sig. = 0.641). This PDF was relevant to the time-consuming process of finalising the project site ownership with the authorities through the Asset Management Department in the SEC. In a few cases, the SEC allowed its Contractors to initiate the project work on the site while the required ownership transfer was not completed. GARA (Contractor) gave an example of when the SEC approved his contracting organisation to start with the project work to build a substation while the work permit was not issued from the Municipality (the site owner). This led the Municipality inspector to issue a warning against the SEC and, as a consequence, the work was suspended for six months. The SEC top management finally stepped in when it was alerted to the severe project delay. The Executive Vice President of the SEC Western Operating Area managed to secure a verbal approval from the Mayor (head of Municipality) to continue with the project work without being bothered by the inspector warnings. GARA (Contractor), who had this particular experience, gave more details:

> We faced that (type of Project Delay Factor), the SEC wants everything for free, whether from us or the Municipality or any other organisation. The substation we were working on was, supposedly, to be let by the Municipality for 10 years. Seven years have already passed and until this day the SEC has not signed the contract with the Municipality (project site owner) and, as a result, they have refused to issue us a permit that was required not only for us to commence the work, but also for specifying the exact borders of the site. This has delayed us for six months. I went to the Investment Manager of the Municipality and he told me that the contract was sent to the SEC in order to get it signed and they haven't received it back yet. He told me "would they have it for free?" The contract went to Riyadh to get it signed. The substation is now operating and the contract has not been signed yet!

6.3.6 PDF 32 ('Delay in change order issuance by the SEC')

According to the SEC Contracting Manual, a change order is a written amendment to the contract's scope of work or service. This PDF indicated the late provision of procurement adjustment requests and the relevant paperwork that were essential for the Contractor to continue with the project work. It represented the sixth highest loading factor of the 'SEC Contractual Commitment' principal component (Sig. = 0.637). A project change order was mostly incurred with additional costs on top of the SEC's allocated project budget. For this particular reason, the process of issuing a change order was perceived as highly challenging. This was partially because of the slow decision making, as will be described in the following PDF, in addition to the excessive explanation required to secure the additional cost on top of the authorised budget. However, change orders with high urgency were usually not considered as problematic to project progress, as ABAB (SEC) explained:

> We sometimes don't have time to wait for the paperwork like when we faced the terrorist attacks. For the foreigners' safety, we asked the Contractor to immediately build a fence surrounding the project site (of the power plant) with proper security systems and staff and we paid when the paperwork was done.

Most of the change orders were mainly initiated and caused by the SEC due to the company being unable to foresee the relevant problem. SAR (SEC) Contract Manager stated:

> I truly believe that change orders hamper the project progress. When the Contractor executes the project something could come up that needs to be added or modified which is not mentioned in the scope of work. So the contractor suspends the work (or the specific activity) waiting for change order issuance with proper compensation. Otherwise, if he delivered what we asked for without issuing the change order the contractor would risk not being compensated.

He also stressed in the same interview that issuing change orders severely impeded Contractor progress and added:

> So change order is the number one reason for project delay. But sometimes our guys miss a few items while preparing the bidding package by not properly surveying the project site and examining the technical limitations. So the scope of work is neither complete nor clear. Even when the Contractor visits the site or attends the Job Explanation, he can miss those limitations.

However, the subject mentioned an interesting point about where the balance of the political forces between the SEC and its Contractor would completely change. In fact, it flipped entirely at the end in this particular PDF.As he expressed:

> The owner is usually in a stronger position than the Contractor. The only situation where the contractor gains more strength is when we change order because then he can control and demand any price when we establish negotiations with him.

6.3.7 PDF 33 ('Slow decision making by the SEC')

This PDF came with the seventh highest loading factor for the 'SEC Contractual Commitment' principal component (Sig. = 0.574) and was ranked 6th by Contractor PMs. AJ (Contractor) pinpointed this particular PDF when asked to list some of the PDFs from his experience with the SEC projects:

> And the third reason is our client Siemens (main contractor) might be very aggressive in moving things forward but our client (SEC) is very very slow in making decisions.

AJ also elaborated on this point in another part of the interview:

> Ahh, a common problem is response time; it is a major problem with the client and lack (of) project ownership is also [another] problem with the client although we do have one identified project manager at the client-end who is responsible for the project but he's not the only authority to make decisions because it's a government organisation that has a hierarchy he needs to follow to escalate any matter and then it goes to the approval process in which 10 signatures are required. So this is one area where the client is (considered) a bottleneck.

Most of the SEC PMs agreed that the slow decision making in SEC was a noticeable PDF that needed to be addressed properly and solved. This particular PDF was highly relevant to the lack of providing the SEC PMs with the required authority.

6.3.8 PDF 26 ('Difficulties in financing the project by the Contractor')

This PDF referred to Contractors facing a predicament in securing financial facilities from financial institutions and banks. These financial facilities were essential to provide the Contractor with necessary resources. This PDF had a non-significant loading factor value for the 'SEC Contractual Commitment' principal component (Loading Factor =0.505 > 0.512). This PDF, however, has become more significant due to the more restrictive banking system as a direct result of the global financial crisis.

6.4 SEC's Communication and Coordination Effectiveness

This Principal Component accounted for 12.88% of total variance explained after the Varimax rotation. Maintaining effective communication and coordination could be considered as a form of 'SEC's Contractual Commitment'. However, applying Factor Analysis to the most important PDFs has resulted in grouping all Communication-and Coordination-related PDFs in a separate Principal Component. This indicated that the relevant issues needed to be addressed thoroughly and with greater depth. It was noticed in the previous chapter that Consultant PMs ranked the Communication-related PDFs group (which also included Coordination-related PDFs) highest, while both the SEC and Contractor PMs ranked this PDFs group 8th (out of 10 groups). Five PDFs contributed to this principal component, as shown in Table 8.9. The last PDF had a non-significant Loading Factor value but the qualitative data along with the ranking analysis result proved that this PDF had a great influence on projects. Therefore, this PDF will be considered as a key element in this principal component of the Project Implementation Challenge of 'SEC's Communication and Coordination Effectiveness'.

Table 6.2: SEC's Communication and Coordination Effectiveness PDFs

PDF	LF	PDF Description
38	0.801	Owner's failure to coordinate with government authorities during planning
36	0.754	Owner's poor communication with related government
37	0.616	Owner's poor communication with contractors and consultants during project execution
39	0.591	Poor coordination by the owner with the various parties during project execution
45	0.485*	Difficulties in obtaining work permits

PDF: Project Delay Factor
LF: Loading Factor value
* Non-significant Loading Factor

6.4.1 PDF 38 ('SEC's failure to coordinate with government authorities during planning')

This PDF represented the highest loading factor which contributed to the 'SEC Communication and Coordination Effectiveness' principal component (Sig. =0.801), and was highly ranked by both the SEC and Consultant PMs (ranked 6th and 1st respectively). As a Project Owner, the SEC was expected to coordinate with several government authorities and share their project plans with these authorities. Sharing the SEC's project intentions with these authorities was necessary for two reasons. The first was that the Planning Department of the SEC needed to secure assurances that the selected project site was technically suitable and clear of any potential problem that may escalate in the near future.

SEC coordination with the relevant government authorities was expected to take place during the project inception phase. Typically, it was under the SEC's Project Planning Department list of responsibilities, while arranging for the project primary scope and during the survey of the potential work site, to investigate any potential limitations that were described above. When asked to comment about the poor coordination between the SEC and government authorities, the answer ORFA (SEC) gave went beyond the posed question:

> Even internally! The coordination between the Company (SEC) and government authorities and even between government authorities themselves is weak. It must improve. For example, when we bought land to build a substation, we then discovered that the Municipality had a plan to build a bridge in the same area that will affect the project. This is poor coordination. Another example was when we started digging, we found large water pipes; this is lack of coordination.

The issue was further investigated with JAWI (SEC) through an explicit question which asked whether the Project Planning Department even coordinated with government authorities. After replying 'No', he continued:

> They coordinate for two and ignore another 10 projects and I know how they think there. They say leave it for the Project Execution Department to handle.

However, it must be acknowledged that issuing the relevant project work permits was very challenging, as will be described more thoroughly in PDF 45 **('Difficulties in obtaining work permits')** below. However, a major concern surfaced when the researcher learned how the SEC dealt with this persistent problem. In an attempt to do what would be seen as the SEC dealing with the problem effectively, the SEC shifted to the Contractors the responsibility of issuing these permits and, hence, coordinating with the relevant government authorities. Not only was the issuing of these essential documents delayed at the project execution phase, the probability of having project plans interrupted by these authorities was also increased. Thus, Contractors were generally having a hard time issuing the required work permits in a timely manner. However, SAR (SEC) Contract Manager thought there was an effective solution:

> We used to follow up with Municipalities to issue these permits but now we shift that to the Contractor and we just support them with letters explaining our project scope and its importance. We think this is better.

To justify his point, the subject elaborated that the reason for shifting the responsibility to Contractors was because they had established long-term business relationships with these authorities and, therefore, the personal relationships with key personnel in these government authorities would have a positive influence on the issuing of the required permits without delays.

6.4.2 PDF 36 ('SEC's poor communication with related government authorities')

As was mentioned in the discussion of the previous PDF 38 ('**SEC's failure to coordinate with government authorities during planning'**), the SEC shifted the responsibility for issuing the project work permits from government authorities to Contractors. Yet, the SEC's cooperation as a Project Owner was crucial to many Contractors to process these work permits during project execution. This PDF represented the second highest loading factor in the 'SEC Communication and Coordination Effectiveness' principal component (Sig. =0.754). The SEC Project Execution Management Departments and Division (in all three business areas of the PG, PT and PD sectors) were expected to issue supporting letters for the Contractors and many times followed up by making phone calls to these authorities. These phone calls were thought to assist Contractors in issuing the required documents faster. Relevant to this problem, HM (SEC) said:

> If he (the Contractor) had problems with the Municipality, we contact them to help out, although it's his job to do that.

For the subject, this apparently presented a lack of 'Project Ownership' tone. GARA (Contractor) presented further evidence of the lack of 'Project Ownership' problem by the SEC:

> Just through letters! That's it. The SEC PM doesn't have the initiative to personally meet with them (Municipality's representative) or follow-up through the phone.

If the letters issued by the SEC or the making of phone calls contributed to the issuing of the required project work permits in a timely manner, then this would not even have been an issue. In some cases, these initiatives (i.e. writing letters and making phone calls) were helping, but in many others they were not. It must be noted, though, that this problem was more apparent in urban areas which were crowded with public projects and, therefore, the coordination between the various stakeholders was more complex. In rural areas, on the other hand, government authorities were keen to have the electrification delivered without delays and, therefore, were supportive.

6.4.3 PDF 37 ('SEC's poor communication with Contractors and Consultants during project execution')

This PDF represented the third highest loading factor of the 'SEC Communication and Coordination Effectiveness' principal component (Sig. =0.616), and was ranked 4th by Consultant PMs. The SEC required both Contractor and Consultant PMs to maintain a frequent flow of information in order to update the project key stakeholders (the SEC Project Execution Department Manager and his superiors) with the project progress and the relevant barriers they were facing. ORFA (SEC) said:

> We demand progress reports once a month and we also conduct design reviews. They know exactly what we want in these reports.

Verbal follow up was also used by SEC PMs as JAWI (SEC) explained:

> I receive verbal reports by phone, and a weekly written report from the Consultant, and a monthly report from the Contractor. We also have weekly or biweekly progress meetings with the Contractors and Consultants to push forward any pending issue to deliver the project on time. This is besides the correspondence letters I need to write in the office.

As ORFA (SEC) said, Contractors and Consultants knew exactly what the SEC wanted in these reports. The main concern was whether the reported information was useful. For example, GARA (Contractor) complained about the fact that the SEC PMs were selective when reading the project progress reports:

> We send monthly progress reports but they don't read them (deeply inhales cigarette smoke)
>
> Researcher:
> How did you know?
>
> GARA (Contractor):
> They only focus on three or four points. But (smokes) if, for example, I explicitly mentioned in any of these reports there will be a delay and mentioning the reason, after two or three months when I state the delay again they jump at me asking 'why didn't you tell us' (SEC). I then have to refer them to the exact report with evidence that the main cause of the delay was having the late approval of our submittals by their consultants!

6.4.4 PDF 39 ('Poor coordination by SEC with the various parties during project execution')

This PDF represented the fourth factor in the 'SEC's Communication and Coordination Effectiveness' principal component (Sig. =0.591), and was ranked 3rd by the Consultant PMs. As was mentioned previously, the SEC was expanding its existing infrastructure by making substantial investments and authorising many different projects. These projects would eventually interconnect with each other as a single integrated system to serve their main purposes (i.e. a power generation plant would be connected to a power transmission grid and these would, in turn, be interconnected with a distribution network). Therefore, extensive coordination between the SEC's various project stakeholders was important to ensure the technical compatibilities of these projects to avoid any operational problems. JAWI (SEC) PM gave an example:

> Since the cables in project (A) are going to be connected to the switchgears in the substation of project (B), which is being delivered by another Contractor, we have to conduct a coordination design review meeting to make sure that the cable will fit into the switchgears. The cable Contractor (of project A) also submits his time schedule to the substation Contractor (of project B) to incorporate it into his time schedule, which is called the master time schedule, and they both need to understand the project requirements.

The above coordination between these Contractors was organised and managed by the SEC PMs for these two projects. Any lack of understanding of the project requirements could lead to catastrophic consequences. Unfortunately, JAWI's project example narrated above went horribly wrong. There was an apparent poor level of coordination between the SEC's Specifications and Design Departments who had designed these two projects. This was evident in not comprehending the project technical limitations of the two projects. The SEC required the Cable Contractor to procure Fibre Optics cables while the Switchgear Contractor working at the other end of the site was required to procure a Switchgear type that required analogue cables. Analogue cables were not brand-new like the Fibre Optics cables and, therefore, the SEC ordered the Fibre Optics cables. However, the Switchgear project was an expansion of an existing old substation and, therefore, the Contractor was required to procure Switchgears in which only Analogue cables could fit. The project descended into chaos, especially since the Contractor had already placed the order and the cables were manufactured. This case, and many others in which projects experienced similar incidents, was a direct result of not conducting a diligent level of coordination between the SEC Departments. In fact, the effectiveness of the coordination within the very same SEC division of employees could be questioned. SAR (SEC) gave the following example:

> The Specifications and Design project team consists of three specialists: one for transformers, one for SCADA (Supervisory Control and Data Acquisition) and one for switchgears. Sometimes there is a lack of coordination between the three, which is essential for studying the technical compatibilities between the three.

6.4.5 PDF 45 ('Difficulties in obtaining work permits')

Although this PDF had a non-significant loading factor value in the 'SEC's Communication and Coordination Effectiveness' principal component (Sig. =0.485 < 0.512), it was the only PDF that was considered among the highly ranked ones according to all three of the SEC, Contractor and Consultant PMs (ranked 3rd, 5th and 5th, respectively).

As was previously described in PDF 38 (**'SEC's failure to coordinate with government authorities during planning'**), securing the required project work permits was one of the SEC Project Planning Department's roles. A project work permit referred to any document that must be issued from the relevant government authority or private entity before initiating the project activities, otherwise project activities would be disrupted. Indeed, many projects were delayed for this particular reason. JAWI (SEC) shared the following experience:

> It always happens in overhead line projects because we need to use both private and public properties. They (SEC Planning Department) should have issued all permits from government authorities and gained permission from the private owners and compensated them if required. Not just survey the site and locate the working area and the next day when the Contractor starts drilling we find someone with a machine gun who shoots in the air to kick us out! This could have been avoided if the Planning Department did their job properly.

As was previously stated, in an attempt to solve the problem of issuing the project work permits, the SEC shifted the role of issuing these permits to Contractors. SAR (SEC) justified this action by noting that Contractors had established working relationships with various government authorities. This, according to SAR (SEC), would ease the process of issuing these necessary permits. Yet, this problem was considered the most common and persistent PDF. In fact, this PDF was the only one in which all three respondent groups (the SEC, Contractor and Consultant PMs) agreed to rank it highly when compared to all other PDFs.

The following example by JAWI (SEC) presents an extreme and rare case where indeed the relationship between the Contractor with the government authorities did play a key role in the easy issuing of almost any required permit:

> This Contractor had only one advantage - he had a tremendous power to issue any work permit. He knew the whole Baladiya (Municipality) and the Traffic Police. He once worked on a motorway without any condition (when others had to only work during off-peak times). It took him only a few hours to get the paperwork done without asking for any supporting letters! This was the only reason why he is still listed as a

> qualified Contractor, otherwise he should be out of the game. He always starts executing in the last six months of the contract.

This particular Contractor, according to the subject, was very difficult to manage. However, having such powers to issue the project work permits in a very short time was considered by this Contractor as an asset for the SEC. Not all Contractors were fortunate to have such a relationship with the government authorities. This was especially true for Contractors who only focused on Electrical Contracting activities and works. They usually have businesses that are limited to the SEC and other private clients rather than public clients. Therefore, they have less public contracts with government authorities when compared to smaller local contractors who focus on project activities in addition to electrical works.

The above showed that issuing the project work permits could be a significant problem. However, the SEC, in some cases, contributed to this problem by not coordinating with the government authorities in the early stages during planning. In another extreme case, the SEC avoided committing contractually to the Municipality, as was previously described by GARA (Contractor) in PDF 29 (**'Delay in furnishing and delivering the site to the Contractor by the SEC'**

6.5 Contractor's Project Planning and Controlling Effectiveness

The Contractor was responsible for turning the SEC's project concept into an operating product. Therefore, the Contractor needed to carefully estimate his available resources to fulfil the project requirements. Project planning in this principal component referred to a Contractor's ability to forecast various variables surrounding the project, while project controlling was concerned with monitoring the project's progress and managing these various variables. This Principal Component accounted for 11.81% of total variance explained after Varimax rotation, and contained five PDFs, as shown in Table 6.3.

Table 6.3: Contractor's Project Planning and Controlling Effectiveness PDFs

PDF	LF	PDF Description
21	0.795	No effective or realistic contingency plans in case the project is behind schedule or over budget
20	0.772	Ineffective planning and scheduling of the project by the contractor
23	0.757	Ineffective control of the project's progress by the contractor
19	0.607	Improper technical study by the contractor during the bidding stage
2	0.552	Delay in materials delivery

PDF: Project Delay Factor
LF: Loading Factor value

6.5.1 PDF 21 ('No effective or realistic contingency plans in case project is behind schedule or over budget')

GARI (Contractor) claimed that

> If everything goes okay without any delay caused by any party, the project can be delivered in 14 months while the SEC wants it in 24 months. Equipment delivery requires the longest lead time of up to 12 months from designing, manufacturing, testing and shipping to the site. The remaining work for installation and commissioning and testing don't take long.

This optimistic statement assumed the project work flow would not be disrupted by, for example, design reviews and approvals by Consultants, placing equipment orders, project site readiness, securing project work permits, performing equipment testing, etc. However, given the highly dynamic nature of a project where all project stakeholders (the SEC, Contractors, Consultants, subcontractors, manufacturers, suppliers, government authorities, designers, etc.) were most probably juggling more than one project, change was inevitable. Therefore, plan deviations were always there no matter how effective the original plan was. The SEC PMs were generally critical of a Contractor's ability to forecast and adapt to plan deviations.

This PDF contributed highly to the principal component ‘Contractor’s Planning and Controlling Effectiveness’ (Sig. = 0.795) and was ranked 4th by the SEC PMs.

Arguably, a plan deviation existed for the following reasons: using unsound planning methodology (detailed in PDF 20 **(‘Ineffective project planning and scheduling by Contractor’)** (see section 8.5.2); lack of accurate project information (i.e. information used was false); project information flow suggest that the project requirements were of a progressive nature; and other forces beyond the Contractor’s control. This PDF referred to the ability to respond to any project plan deviation that required an effective identification and response to project risk. A project risk was defined by the PMBOK as “an uncertain event or condition that, if it occurs, has a positive or a negative effect on at least one project objective, such as time, cost, scope, or quality.”

When discussing PDF 45 (**‘Difficulties in obtaining work permits’)**, JAWI (SEC) gave an example of a Contractor who was blessed with the ability to issue the required project work permits when all SEC, Contractor and Consultant PMs agreed that the issuing of the permits was a great concern. The problem with this particular Contractor was that he started the project activities in the last six months of the originally scheduled 24-month contract.

Yet, he was described as very fast in execution when compared to other Contractors and was able to lay 500 meters of cable per day (out of a total 6 kilometres). This type of project (Power Transmission underground cable project) was commonly known for its potential problem of changing the cable-routes, especially in urban areas. In fact, the original project cable-route did appear to cross a private property but the Contractor had not predicted that the route might change. The Contractor suggested a new shorter route and the SEC approved this new route. The project was delivered but was also followed with prolonged discussions between the SEC and the Contractor. The cable price (made of copper) increased considerably during project execution and the Contractor claimed for price adjustment while the SEC was not satisfied with the delayed project execution. The SEC's argument was that if the project had started on time rather than in the last six months of the time period scheduled for the project, the cable would have been purchased at the previously agreed price. The example showed a flaw in the Contractor's practice in a project that was commonly known to have its cable-route changed. Although the Contractor relied on his fast execution rate, he apparently ignored the probability of a cable-route change being required and failed to take into consideration volatile cable prices.

6.5.2 PDF 20 ('Ineffective project planning and scheduling by Contractor')

Project planning was the most critical process that had a direct impact on meeting a project's primary objectives of scope, budget and time schedule. This PDF will describe the Contractor's ability to estimate the project work volumes and the required resources to carry out the project activities. The following are the accurate project resources estimations which are required: the availability of reliable information from the client, which has already been described by ORFA (SEC) as a source of difficulty for Contractors, information flow in a timely manner and sound planning methodology. Information availability and accuracy were a great concern for Contractors, as will be detailed in the 'SEC's Tendering System' and 'Lack of Project Requirements Clarity' Principal Components. This PDF had the second highest loading factor value (Sig. = 0.772) and was ranked highly by the SEC PMs (ranked 8th).

Contractor planning started from the bid/no-bid decision when the SEC called for project RFPs (Request for Proposals). All details relevant to bidders conducting comprehensive technical studies that were based on the bidding documents will be discussed in 'SEC's Tendering

System' Principal Component. The chosen Contractor was required to submit a project schedule plan to the SEC PM who would review it and then approve the plan. In this plan, major deliverables and activities were distributed over the project contract period.

The general attitude towards Contractors' project planning ability was a point of concern. ORFA SEC PM was asked to comment on this particular PDF. Although he was managing projects with international Contractors at the time, he said:

> Ohooo! (implying disappointment). I have never seen a Contractor who is good at it. No one is good! They don't have experienced people - for example, the time schedule. I have never seen a realistic schedule.

BARAK (SEC) gave an example of a 'nonsense' schedule plan:

> I had a project in Makkah and I had been discussing the time schedule for 2 to 3 weeks with the Contractor until the moment I decided not to approve his schedule due to it being nonsense. I could find many mistakes. For example, the installation date was after the testing date and many other silly mistakes. Even the tools used in the time schedule were very basic. You can't see a Critical Path Method for example.

6.5.3 PDF 23 ('Ineffective project progress control by Contractor')

The aim of monitoring the project progress was to ensure that the project objectives were being delivered on a regular basis. The mutual project objective between the SEC and Contractor was delivering the project on time. Therefore, the Contractor was obliged to regularly report to the SEC with a detailed project progress status. This PDF had the third highest loading factor value contributing to the Principal Component "Contractor's Project Planning and Controlling Effectiveness" (Sig. = 0.757).

In general, SEC PMs were more critical of Contractors' project control effectiveness (ranked 7th highest). Being involved with other public projects made project priority management a central issue for Contractors. This was especially true for Contractors who faced serious resource shortages (financial, manpower, material, etc.). The SEC used to force a contractual condition where the Contractor had to assign one PM who should only manage one project at a time with the SEC in addition to not being involved in any other public projects. However, the large number of ongoing public projects in Saudi Arabia forced the SEC to relax the condition and assign one site manager per project rather than a PM. In fact, the number of projects that needed to be delivered for the SEC alone was very challenging and this forced the SEC to award project contracts to Contractors who indeed lacked adequate resources. ORFA (SEC) gave the following example:

> Sometimes we award a contractor 15 projects in one year though he can't deliver all of them. We shouldn't have invited him from the beginning, but if we hadn't then he would query why he wasn't invited (laughs). We must evaluate his capacity, I don't know how, but we should.

Awarding projects beyond a Contractor's capacity had a direct impact on maintaining effective project control. It seemed, though, that the SEC was left with no other options since the capacities of all qualified Contractors were limited when compared to the size of SEC's expansive ongoing projects.

6.5.4 PDF 19 ('Improper technical study by Contractor during bidding stage')

Effective planning required thorough understanding of the technical needs of the SEC projects. When compared to normal construction projects, the SEC projects involved highly advanced technologies and equipment. Comprehending SEC project requirements was a challenging aspect for Contractors. This PDF was concerned with the surrounding issues which contributed to the conducting of improper technical studies of the SEC project requirements during the bidding stage. This PDF had the fourth highest loading factor value that contributed to the ‘Contractor’s Project Planning and Controlling Effectiveness’ Principal Component (Sig. = 0.607).

After studying the bidding documents, visiting the project site and attending the job explanation meetings, the lowest bidder risked not being allowed to adjust his offer price after submitting his official bid to the SEC Contracting Department. Moreover, the competitive bidding climate squeezed the serious bidders into a compromise between achieving the desired project profit and being the lowest bidder to win the contract. Therefore, careful and thorough study of SEC project technical requirements was crucial for better and improved project resource estimation and planning.

The SEC research subjects generally believed that the Contractors did not thoroughly read the bidding package. WALA (SEC) explained why this was so:

> He (the contractor) assumes that the project is just a replication of the previous ones since there are few original items which are explicitly listed in the bidding documents - for example, additional design work or more activities in a larger site area. The problem is they do not read the contract thoroughly.

6.5.5 PDF 2 (‘Delay in material delivery’)

The research participants did not distinguish between materials (such as steel, cement, bricks, etc.) and equipment (drillers, transformers, boilers, etc.). Therefore, equipment-related issues will be described alongside material-related issues. This PDF was concerned with the issues that delayed the supply of both materials and equipment to the project site. Although this PDF had the lowest loading factor value which contributed to the “Contractor’s Project Planning and Controlling Effectiveness” Principal Component (Sig. = 0.552), it was highly ranked by both the SEC and Contractor PMs (ranked 2nd and 4th, respectively).

Supplying both materials and equipment in a timely manner proved to be very challenging in the investigated project industry. The research data collection took place while the global economy was experiencing a period of expansion. The global economic growth was reflected in the increasing demand for various materials and equipment used in a wide range of construction projects. AJ (Contractor) gave an example of a materials availability problem:

> These days (2007) because of the booming market, resource (availability) is a problem everywhere, not only in one organisation - all organisations are having these sorts of problems in terms of manpower and availability of raw materials. We had a project in Qatar which was cancelled because no cement was available in the country, so the project couldn't go through. Let's say lack of resource problem is there these days.

Equipment manufacturing was another soaring problem. The lead time to when the equipment would reach the project site was increasing as a result of the growing demand for various types of equipment. AJ (Contractor) gave an example of this particular problem:

> If I talked only about Siemens, the transformer manufacturer says the delivery will take place in two years from now while other manufacturers are quoting 18 months delay. If I placed an order now I would have it in a year and a half while the project lifecycle is only 21 months. So I am left with only three months to ship them from Belgium by sea to Saudi Arabia, unload it, take it to the site, install, test, (and) commission it, which is very hectic.

The researcher had an informal chat with a Contractor PM who represented Alstom in Saudi Arabia. Alstom was a French Contracting Company and was involved in delivering the largest water desalination utility in the world to date (as of 2010) and which also produced electricity (the Al-Shuaiba project). He mentioned in 2007 that he tried to place an order for several gas turbines for the Power Generation project. These were normally delivered in two years but the mother Company's factory in France had many orders lined up. Therefore, it was able to deliver the gas turbines before 2014. According to him, Chinese customers were ordering turbines in quantities that were beyond the factory's capacity. In fact, the Chinese were keen to purchase orders at premium prices from queued customers waiting for their turbines to be manufactured to have more of these gas turbines delivered before 2014. This clearly shows that the global economy factor played a key role in the supply-demand gap for the required materials and equipment, causing delivery delay for the required items.

6.6 Consultant-related

The SEC outsourced Consultants mainly to review the detailed engineering designs submitted by the Contractors. These Consultant engineers were also involved in monitoring the project site and the work progress. They were also required to deliver written and verbal reports to the SEC PMs with regards to the Contractor performance. Their presence during the inspection and testing of the major deliverables was important since before commissioning and connecting the project with the existing Power System they provided their technical evaluations of these deliverables. This Principal Component accounted for 11.2% of the total variance explained and consisted of four PDFs, as shown in Table 6.4.

Table 6.4: Consultant-related PDFs

PDF	LF	PDF Description
54	0.763	Delay in the approval of contractor submissions by the engineer
58	0.727	Slow response from the consultant engineer to contractor inquiries
57	0.639	Delay in performing inspection and testing by the consultant engineer
55	0.547	Poor communication between the consultant engineer and other parties involved

6.6.1 PDF 54 ('Delay in the approval of contractor submissions by the engineer')

Consultant engineers in both Power Generation and Power Transmission projects were contracted by the SEC to review the detailed technical drawings and designs submitted by the Contractors. They gave their technical decisions to approve or reject the offered specifications in the Contractors' submittals. In Power Distribution projects, the SEC PMs were the ones who reviewed the Contractors' submittals. The Contractors were keen to have their submittals reviewed and approved without delays so they could place orders for the materials and equipment with the manufacturers and suppliers. Any delay in approving the Contractor's submittals had, in many cases, a direct effect on project delivery duration. This was especially true for approving submittals of large equipment (such as gas turbines and transformers) that would normally take several months to manufacture, followed by the required inspection, testing, installation and commissioning. This PDF had the highest loading factor in the Consultant-related Principal Component (Sig. = 0.763). It was also the Contractors' main concern, as their PMs ranked it second. It was the only PDF that was among the top ten ranked PDFs according to all PG, PT and PD PMs. This indicated that the SEC PMs in Power Distribution projects were also delaying the approval of Contractor submittals.

Many Consultants had wide experience with the SEC projects. Therefore, it was expected that having implemented similar projects within a specific field with the same client would lead to an improved and faster practice and better understanding of these conducted projects. Moreover, Contractors were keen to outsource the engineering works and services to Designers who were experienced with the SEC projects. This would even reduce the chances of having errors in the submittals. In practice, however, it was evident that approving (or rejecting) Contractors' submissions in a timely manner was often not possible and led instead to serious delays. AJ (Contractor) did not see the matter as a phenomenon, but still acknowledged the existence of the problem:

> And it also depends on the individuals -people are hiring Consultants who operate in between us so let's say if it was (an) extension job it is simply copying the previous project and pasting it into the new project. So if we submitted the same drawings for a project which is already being commissioned there should not be any problems but still we get comments from the client that this is not correct and that is not right. The consultant in between us is trying to justify his position. So that depends on the individual who is involved in between.

On the other hand, SAR (SEC) had a different view as a Contract Manager in the SEC. He previously addressed the point that time extension claims by Contractors were mainly because of the delay in Contractors' submittals approvals. In contrast to AJ (Contractor), SAR (SEC) thought this PDF was a phenomenon:

> This is one of the most important factors Contractors complain about. If they (Contractors and Consultants) agree to have the approvals in a month, they (Consultants) take two. They (Consultants) usually ask for many adjustments. All of us are bored with, for example, 110 KV substation design - we always proceed with the same projects and designs and if there is any change it shouldn't take that long. So being stubborn and taking longer time is not excusable and will get on the Contractors' nerves. It could be something personal.

6.6.2 PDF 58 ('Slow response from the consultant engineer to contractor inquiries')

In many cases, the Contractors and their outsourced Designers had questions relevant to the SEC drawings and specifications in the bidding package. For expansion projects, these drawings described the existing power systems. Having answers to these inquiries was critical for the Contractors if they wished to avoid any unnecessary reworking of designs and avoid having their submittals rejected by the Consultants.

This PDF had the second highest loading factor value in the 'Consultant-related' Principal Component (Sig. = 0.727). It was also ranked highly by both Contractor and Consultant PMs (ranked 7th and 8th, respectively).The following presents an example, narrated by WALA (SEC), which reasons why Consultants had a slow response:

> When the (Consultant) engineer lacks the adequate experience, he fears taking risks; so, he prolongs the process through shocking acts such as rejecting the submissions because the letter format, for example, was not right. So, he asks the Contractor to place the SEC logo in the middle of the line rather than on the side.

6.6.3 PDF 57 ('Delay in performing inspection and testing by the consultant engineer')

After major equipment such as gas turbines, boilers, transformers, switchgears, etc. had been manufactured; the Contractor PM would notify the SEC PM to issue a Release of Shipment letter. This would be issued after inspecting the equipment in the factory with the attendance of the SEC representatives and the Consultant PM. Other tests were required in the project site before final commissioning and integrating of the new project into the existing power system. This PDF was concerned with the late execution of the necessary inspections and testing caused by the Consultant engineer. It had the third highest loading factor value of the 'Consultant-related' Principal Component (Sig. = 0.639), and was highly ranked by Consultant PMs (ranked 5th). This PDF was, to a great extent, relevant to the shortage in Consultant's manpower, as will be discussed in the Principal Component of 'Manpower Challenges and Material Uncertainties'. This explained why this PDF was ranked highly by Consultant PMs only. Moreover, the delay in performing equipment inspections and testing was not only caused by the Consultant engineer since it was evident that the SEC also played a key role in this type of delay. The SEC PMs repeatedly complained about the difficulty of coordinating with the Project Proponent representative the arrangement of a power system shutdown and their attendance at the test. SAF (SEC) explained that arranging for a system shutdown was a sensitive matter and, therefore, the operator needed to carefully analyse the consequences on the grid:

> When performing the on-site testing, the delay mostly happens in expansion projects for existing plants when the shutdown is required but considered critical at the same time. And since this would have an effect on the grid, it takes time and this delays the project.

6.6.4 PDF 55 ('Poor communication between the consultant engineer and other parties involved')

This PDF was ranked highly by Consultant PMs (ranked 8th). It had the lowest loading value in the 'Consultant-related' Principal Component (Sig. = 0.547). The official means of communication between Consultants, the SEC and Contractors was through written letters. However, it was evident that pending Contractor submittal approvals or inquiries could have been addressed and solved in a five minute meeting, as JAWI (SEC) described below. He appreciated having short meetings with Contractors and Consultants because “letters will result to nothing”. These face-to-face meetings effectively resolved pending issues, but “there is a lack of such meetings”. However, JAWI (SEC) presented evidence of the inefficient communication practice:

> There is no face-to-face contact. What we use is internal correspondence using letters (between the SEC and consultants) while sometimes it's only an easy question that could have been addressed in a five minute meeting which would have yielded the answer or the relevant documents instead of the long loop that the Contractor’s inquiry has to go through till it reaches the Consultant through me and then I forward it back to the Contractor when the Consultant replies.

Clearly, this showed that the SEC PM could have a significant role to play in maximising the communicative efficiency of both the Consultant and Contractor PMs.

6.7 Manpower Challenges and Material Uncertainties

Projects are conceptualised, planned, designed, executed, monitored, delivered and operated by people. Manpower refers to all individuals involved in the investigated project industry, whether they represent the SEC, Contractor or the Consultants. Manpower and material fluctuating prices and availability were variables with significant challenges and uncertainties, as will be discussed below. This Principal Component accounted for 6.56% of total variance explained and consisted of three PDFs, as shown in Table 6.5.

Table 6.5: Manpower Challenges and Materials Uncertainty PDFs

PDF	LF	PDF Description
9	0.794	Low skills of manpower
3	0.577	Changes in material prices
8	0.524	Shortage of manpower

6.7.1 PDF 9 ('Low skills of manpower')

Projects required manpower with a specific set of skills in both technical and managerial aspects. This study focused mainly on the skills of the manpower representing the three key project stakeholders of the SEC, Contractors and Consultants because their manpower much of the project from inception to closure. This PDF had the highest loading factor value in the Principal Component of 'Manpower Challenges and Material Uncertainty' (Sig. = 0.794). The SEC PMs highly ranked this PDF (ranked 9th). Starting with the owner's project managers, ABAB (SEC) admitted:

> So, basically, we must improve our employees and honestly they (the SEC Top Management) must consider selecting the right people to manage projects. It happens when there is poor project manager selection.

Most of the SEC PMs were employed as fresh graduates with no prior work experience. Their knowledge was limited to technical aspects learned in the academic institutions, although such knowledge was only of trivial technical terms. Most of the SEC PMs who participated in this study admitted their need to attain managerial skills to better manage their assigned projects. ORFA (SEC) even sympathised with Contractor PMs as some secretly complained to him about his PM colleagues who represented the SEC. He explicitly stated that some PMs demonstrated hostile behaviour, which suggested a Master-Slave attitude between the SEC PMs and the Contractors.

It could be argued that the SEC PM behaviours were reflections of their superiors' 'bossy' attitudes. BARAK (SEC), for example, pointed to the need to address the working relationship between some Project Division Managers and their PMs:

> Sometimes we had division managers with weak personalities and some had very strong and controlling attitudes which could kill the project team enthusiasm. So, I think they (Top Management) should be aware of this point through better selection or better direction and guidance of this group.

Therefore, he called for better project staff selection to sustain the team's enthusiasm, which was consistent with ABAB's (SEC) statement above. Both subjects held the Top Management responsible for not selecting project members with the appropriate skills. However, BARAK (SEC) expressed wider concerns about selecting members who worked in the earlier stages of the project:

> The Top Management may partially be responsible for selecting the right people for project execution. I don't mean project execution the phase itself but I mean the whole process from planning, identifying the specifications - all these are important phases in the project so either select the right people for the job or at least question them in case the project is delayed or troubled.

Most participants considered the Department Manager and his superiors as Top Management. As could be sensed by BARAK's (SEC) tone in "may partially be responsible", relating the flaws and mistakes of Top Management was not usually discussed openly.

The Specifications and Design Department engineers were also heavily involved in the SEC projects. They elaborated on the project primary scope developed by the Planning Department. They specified the project requirements for major equipment and made sure the procured equipment and materials were technically compatible with the existing Power Systems. They provided relevant designs and drawings to assist the bidders to submit offers with better estimations. It was previously mentioned that Specifications and Design engineers showed a lack of coordination in the very same division as SAR (SEC) stated (see section 8.4.4).This poor coordination was easily spotted by the Contract Manager, who requested them to carefully review the package. The transformers, SCADA and switchgears, for example, were not technically compatible and, therefore, the bidding stage was unnecessarily prolonged. Besides the coordination downside, which represented a managerial weakness of the same division members, there were a few other major technical errors in the specification and design inside the packages submitted to the bidders. Contractors usually spotted these technical errors when the Specifications and Design engineers requested non-applicable specifications in the bidding documents. Therefore, the SEC Contracting Department had to rectify these errors by issuing Contract Addendums. A Contract Addendum referred to major project scope deviations. This indeed delayed the project award deadlines. When SAR (SEC) was explicitly asked whether the technical abilities of the SEC Specifications and Design engineers were reasons for having more frequent Contract Addendums and, therefore, were the cause of project delays, he said:

> Sometimes it is the reason (acknowledgment tone). I would say that, say in two years, each bid had 5 to 6 addendums but lately we have had one or two addendums. An addendum means change in project scope that is a major addition or removal from the main project scope.

Although not as usual, the SEC Top Management officers were not exempted from direct criticism. SAR (SEC)gave an example of a non-constructive intervention by an Executive Director. Both of his subordinates, the Project Execution Department Manager and Project Specifications and Design Department Manager, lacked a common understanding with regards to procuring specific equipment during the bidding negotiation stage with the bidders. The Project Execution Department Manager experienced an operational flaw in the equipment suggested by the Specifications and Design Department Manager. The latter, however, insisted on procuring the suggested equipment. Both Department Managers were located in the Western Operating Area while the Executive Director (i.e. direct boss) was in Riyadh, the Capital (Central Operating Area). The issue escalated and gained the attention of the

Executive Director in Riyadh who pulled the Project Execution Department Manager from the negotiation team and ceased any future involvement of the Department in bidding negotiations. Not being involved in such a critical project phase had negative and serious consequences, as will be seen in the 'SEC's Tendering System' Principal Component.

6.7.2 PDF 3 ('Changes in material prices')

The SEC mainly used a Fixed Lump-Sum contract type for its turnkey projects. This was an additional challenge for Contractors since the risk of material price increases was entirely shifted onto them. Material prices were subject to change due to many external factors, especially those relevant to supply-demand forces. HM SEC PM recognised several PDFs, but this particular PDF was his main concern:

> All projects are associated with problems whether from suppliers, contractors, commitment problems between contractors and manufacturers when the prices change. We have experienced that many times. Materials price change is one of the main problems that face our contractors.

This unexpected PDF had the second highest loading factor value in the 'Manpower Challenges and Material Uncertainties' principal component (Sig. = 0.577). AJ (Contractor) pointed out to what extent the material prices had changed and, therefore, had an impact on project cost:

> Mostly cost overruns could be on account of currency exchange variations, and these days because of raw material price increases, copper and sheet steel is something no one is able to forecast prices for in the very near future. I had a case in October (2006) when a cable was charged at 160 Riyals per metre. Today (after 9 months) the cable is 380 Riyals per metre, so it's gone up two and half times. Nobody expected that.

This presented evidence that even those Contractors who were blessed to plan in their projects with the SEC even with basic methodologies, faced material price changes during project execution. Therefore, these Contractors were forced to save the project budget for works relevant to other activities in order to recover the potential losses. This inevitably reduced the Contractors' work quality, which eventually led to disputes with the SEC and created a mistrustful working climate.

AJ (Contractor) explained that manufacturers and suppliers were accepting orders that were beyond their capacities at the time:

> These days, because of the booming market, all manufacturers are overloaded with orders and some of them out of excitement and business eagerness they have taken projects which they are not able to fulfil. They have huge inventories in their factories and they're not able to deliver in time. So this is one cause of delay.

6.7.3 PDF 8 ('Shortages of manpower')

All three (SEC, Contractors and Consultants) had this universal project problem. This PDF had the lowest loading factor value which contributed to the 'Manpower Challenges and Material Uncertainties' Principal Component (Sig. = 0.524). It was highly ranked by the SEC and Contractor PMs (ranked 10^{th} and 3^{rd} respectively). The Kingdom was executing huge development projects but the SEC was struggling to provide sufficient electricity supplies. This resulted in the authorisation of many projects by the SEC, and these were indeed beyond its human resource capacity. This resulted in increases in the number of projects managed by the SEC PMs. The researcher, for example, met ORFA (SEC) in 2007 when he was managing 5 projects; by 2009 he was managing 9 or 10 projects. The subject was not sure whether he was managing 9 or 10 projects, which indicated the project overload needed to be properly addressed. This problem worsened when the SEC faced high employee turnover in 2008.

Contractors and Consultants also suffered from this persistent problem. Driven by the high unemployment rate of Saudi Arabian citizens, Labour-Supply Laws from abroad were restrictive. This prevented the Contractors and Consultants having adequate manpower for their awarded projects. As a consequence, most Contractors and Consultants committed to deliver projects that were certainly beyond their available manpower capacities. Contractors and Consultants were very eager not to lose any bid, whether with public, private or SEC projects. This, consequently, caused serious project delays.

6.8 SEC's Tendering System

This sixth Principal Component accounted for only 5.0% of the total attractive variance after applying Varimax rotation. However, this Principal Component consisted of only one PDF, and this was PDF 46 (**'Owner's tendering system requirement of selecting the lowest bidder')** (Sig. = 0.809). It also had the highest loading factor value when compared to all other PDFs that contributed to their Principal Components. This PDF was ranked highest by both the SEC and Contractor PMs but was not even among the Consultant PMs' highly ranked PDFs (ranked 20th). It was understandable why Contractor PMs chose this PDF as the issue they were concerned about most. An openly competitive bidding environment forced the serious bidders to lower their profit margins, leaving them with tight financial constraints in order to win the bid. However, in having the SEC PMs perfectly agree with the Contractor PMs about the importance level of this particular PDF, it indicated there was a common ground between the two. Having a common ground between the two presented the opportunity to narrow key project problems in the industry, but criticising the very same PDF by ranking it as the most important delay factor indicated there was a persistent and complicated phenomenon in the industry.

The SEC Contracting Department perceived that adopting the policy of selecting the lowest bidder was a justifiable method for providing the Company with the best value for projects. This was because the selected qualified bidder was assumed to procure all deliverables stated in the bidding package arranged by the SEC with the lowest possible price. Yet, it was ranked highest by the SEC PMs, who obviously completely disagreed with this adopted policy. Another interesting observation was that this PDF was also ranked highest by both Power Transmission and Power Distribution PMs, but was not even among the Power Generation PMs' highly ranked PDFs (ranked 28th). Addressing the surrounding issues that contributed to selecting this PDF as being of most concern in this industry was crucial to delineate the Project Implementation Challenges. It is important to remember, however, that the dynamics of the surveyed PDFs in this study presented complex interrelationships between these challenges. This was especially true for this PDF since the tendering process could extend for up to two years, depending on the project type. Therefore, having other PDFs surfacing during the tendering process was highly expected.

Bidding package arrangement

This research study perceived the arranging of the bidding package as the most controversial project phase in SEC. This was because the package should provide the detailed engineering requirements and product specifications of a project, and all participating bidders should base their technical and financial offers on the information provided in this package. Therefore, the 'tendering' stage was considered the most 'critical' stage in the SEC projects. The bidding package which eventually developed into a binding contract between both SEC and the selected Contractor, proved to be a cause of continuous disputes and claims between the two. These complicated contract administration for both.

Before portraying illuminating and relevant details, a crystal clear disparity is noticed between both SEC and Contractor PMs who ranked this PDF highest, while the same PDF was ranked 20th by the Consultant PMs. The main reason was that Consultant PMs were not involved in arranging the bidding package for the SEC. Therefore, Consultant PMs lacked any understanding of the details surrounding this particular project stage since they were distant from it. However, it could be argued that this PDF, for example, had a direct impact on having

PDF 58 **('Slow response to Contractor inquiries from the Consultant engineer')** ranked highly by Consultant PMs (ranked 8th). In other words, the lack of contract details clarity, which was originally formed from the bidding package, could have caused the slow response of these Consultant PMs to Contractor enquiries. This showed that PDF 46 **('Owner's tendering system requirement of selecting the lowest bidder')** contributed to the performance of these Consultant PMs.

It is interesting to note that the SEC entirely relied on its in-house engineering abilities to prepare the bidding package in both Power Transmission – through the Specifications and Design Department - and Power Distribution projects – through the Technical Support Division. In Power Generation projects, however, the SEC relied on external international designers in collaboration with the Specifications and Design Department to arrange the bidding package. The outsourced international designers were expected to have more skilful engineers when compared to the SEC engineers. This partially explained why this PDF was not highly ranked by PG PMs compared to both PT and PD PMs (ranked highest). This was despite the fact that Power Generation projects were much more complex when considering their size and the number of activities required to deliver the project compared to PT and PD projects. Another important observation that might have contributed to it not being ranked highly by PG PMs was that just over one third of PG PMs were Consultants (i.e. 11 responses out of the total 32 PG responses were from Consultants) (Table 5.4). These Consultant PMs did not highly rank this PDF (ranked 20th). Therefore, this would be another reason explaining why this PDF was not highly ranked by the PG PMs.

Prequalification

> "The problems we faced were with pre-qualified contractors. Imagine how it would have been if we hadn't had the process!" Dr. Khoshaim

The SEC Contracting Managers were proud of the screening process that created a borderline between eligible Contractors who could be expected to deliver projects and meet the SEC requirements and those who did not have the available resources, set of skills and experience to qualify for being invited to bid. However, there were noticeable threats and weaknesses surrounding the existing SEC prequalification requirements. SAR (SEC) admitted:

> If I show you the list of our qualified Contractors, they are all well known. Problems happen with those who just got qualified based on their experience in delivering other construction public projects with the Municipality, for example (undermining tone towards public projects). When they start working with us, they are shocked at our requirements and set of specifications.

The above statements and many other similar ones during conversations with the SEC PMs showed that their projects were perceived to have a better project delivery quality when compared to all other public projects. Therefore, accepting new local Contractors to bid for projects with the SEC based on their project experience was not a sound measure since there was already a low level of expectation on the delivery of public projects. Having a set of complex project requirements with the SEC compared to other public projects increased the risk of experiencing troubled projects during execution if these were awarded to new entrants who lacked any relevant project experience.

The SEC PMs were, in general, concerned with the project performance of all Contractors, but all SEC PMs particularly expressed frustration at the newly qualified Contractors who were still learning to cope with the SEC project requirements. When the researcher asked SAR (SEC Contracting Manager) why the SEC PMs considered this particular PDF to be their highest concern, he immediately replied:

> I will tell you why. They (SEC PMs) should think of that if there was no sound prequalification system for contractors. The SEC regulation states that we may allow those who are technically acceptable. When we say “accepted” we implicitly judge that as “bad”. But what we mean by ‘accepted’ is those who are able to provide the minimum

> requirements to execute a project. Those who work in the Project Execution Department do not want those who are barely accepted, they want those who have excellent performance and abilities so their jobs become easier for them. I would agree with them if we didn't properly qualify those contractors from the beginning. But in Transmission Projects we have a sound qualification system. Sometimes a few new small sized Contractors who were not properly qualified have caused troubles for the Project Execution Department. They were either unproductive in terms of their labour or had weak project supervision.

The researcher did not entirely agree with SAR (SEC) that the Company had a sound prequalification system since, as he claimed, the Company accepted new Contractors with poor performance. It was expected that any new entrant in the Contracting business with the SEC would not have a sound performance at the beginning. The problem, though, of having an ineffective prequalification process was deeper. The relatively low number of qualified Contractors was clearly not sufficient for carrying out the SEC announced projects. Therefore, the SEC seemed to be forced to qualify more Contractors who had supposedly delivered public projects with acceptable performance. This observation was supported by the fact that the SEC was awarding projects to their qualified Contractors while being certain these projects were beyond their resource capacities. Coupled with the Contractors' eagerness to win as many projects as possible, these factors have indeed contributed to project delays in the SEC. Relevant to this, ORFA (SEC) said:

> We must evaluate his capacity, I don't know how, but we should. We gave a Contractor 12 projects and all of these were delayed and some of them were delayed for over a year. In addition, the problems we face with project number one we face the same problem with project number 11. It's as if you put all your eggs in one basket. But here we all know our Contractors, unfortunately. Their performance does not meet expectations.

Bidder offer analysis by the SEC

All bidders were supposed to submit both their financial and technical offers by a specific deadline for the SEC evaluation. The main difference between PG projects and both PT and PD projects was the method of submitting the Contractors' offers. Primarily, as was the case in most PT and PD projects, the SEC used the one-envelope method that contained both the financial and technical offers. These financial and technical offers were revealed together in the presence of all bidders. The technical offer of the lowest bidder (i.e. with the least financial value) was subjected to an extensive review. If the lowest bidder complied with SEC's technical requirements then he would be awarded the project. Otherwise, the SEC would conduct an extensive review of the second lowest bidder's technical offer.

In PG projects and a very few large PT projects that were worth hundreds of millions of Riyals and were described in the SEC Contracting Manual as "non-repetitive projects with high values", the technical offers of all bidders were first analysed while the financial offers remained with the bidders. After conducting the technical evaluations, only bidders who were technically compliant were requested to submit their financial offers. The bidder with the lowest financial offer would be awarded the project. This was known as the 'two-envelope" tendering method. This method of tendering was perceived as another potential reason why the PG PMs did not highly rank PDF 46 (**'Owner's tendering system requirement of selecting the lowest bidder')** compared to both PT and PD PMs. Although the two-envelope tendering was indeed more time consuming when compared to one-envelope tendering, this method proved to minimise disputes between the SEC and Contractors during project construction. In fact, this method was suggested by the Power Generation Project Execution Department and was approved by the Contracting Department. This method replaced the one-envelope tendering method when it was confirmed it was the cause of prolonged disputes with Contractors during project execution.

In PT and PD projects where the one-envelope tendering method was used, the SEC Bid Review Evaluation Team reviewed only one technical offer which was submitted by the lowest bidder. Therefore, the offer analysis in this method was conducted in much less time when compared to the offer analysis in the one-envelope tendering in PG projects. This was especially true knowing that PT and PD project sizes were smaller than those in PG. Moreover, the SEC tended to award their projects to the lowest bidders and rarely analysed the second lower bidder offers. This indicated that the offer analysis was conducted almost at once in PT and PD projects but was, indeed, surrounded by criticisms.

Lowest bidder issues – one-envelope tendering

In PT and PD projects, bidders with the lowest offers were generally seen as trouble according to the SEC PMs. Unlike in PG projects, many false assumptions were in the lowest bidders' technical offers. In all three project types, the SEC conducted Job Explanation sessions to clarify any ambiguity in the bidding packages. The SEC projects, however, were complex and, therefore, the bidding packages were likely to have mistakes and inconsistencies. Although PG projects were much larger and more complex than those in PT and PD projects, the main difference was having the opportunity to discuss the technical offers of all qualified bidders in PG projects in greater depth. Unlike the one-envelope tendering method, PG bidders submitted their financial offers after each was familiarised with the likely project activities and, hence, could better estimate the required resources. This highly intensive and time consuming process at least minimised uncertainties relevant to major changes in the project scope.

In the one-envelope tendering method, on the other hand, the false assumptions of the lowest bidder's technical study surfaced while he was committed to the submitted financial offer. Therefore, the major technical deviations found in their offers more likely required additional resources, but they were not allowed to change the final price. The bidders' false technical assumptions were partially reasoned by the ambiguities of the SEC requirements in their bidding package. However, there was a major concern about the SEC's conduct with the lowest bidders. In several cases, Contractor PMs and the SEC PMs noted the unfair behaviour of the SEC's Bid Review Evaluation Team who was seen to force the lowest bidders to procure additional deliverables without changing the price offer. The main reason behind this behaviour was that the Bid Review Evaluation Team discovered the main bidding package was missing these essential deliverables. Therefore, to avoid any embarrassment with the SEC Top Management by requesting additional financial reinforcement, the Bid Review Evaluation Team normally applied pressure on the lowest bidder to accept the new conditions. Because the lowest bidders were most likely very eager to win the project, the Bid Review Evaluation Team tended to establish negotiations with the second lowest bidders in case the lowest bidder resisted complying with the SEC's newly introduced requirements. With regard to this, SAR (SEC) said:

> They (lowest bidders) agree especially if there is tight competition between the lowest and the second lowest offers. This presents a great risk for him to lose the bid, so he accepts.

During the bid offer analysis stage, only the major deliverables were discussed and analysed, and yet some of these were missed on occasion. This represented two probable risks for Contractors. The first was that the SEC would discover other missing and essential major deliverables during project construction after awarding the project to the Contractor. This presented an opportunity for the Contractor since these new deliverables would be procured with a separate 'change order', and these were normally at higher prices. The other probable risk was in procuring the auxiliary parts of the project. These non-major deliverables were normally approved during the project construction.

6.9 Lack of Project Requirements Clarity

Clarity of project requirements minimised activity assumptions and, consequently, improved the degree of certainty towards the essential resources. This seventh Principal Component of 'Lack of Project Requirements Clarity' accounted for only 5.0% of the total variance explained after Varimax rotation. This Principal Component consisted of two PDFs (Table 6.6). These PDFs were PDF 41 (**'Ambiguities, mistakes and inconsistencies in specifications and**

drawings') (Sig. = 0.629) and PDF 40 (**'Changes in the scope of the project'**) (Sig. = 0.482). The latter PDF had a non-significant loading factor value (Sig. = 0.482 < 0.512).

Table 6.6: Lack of Project Requirements Clarity PDFs

PDF	LF	PDF Description
41	0.629	Ambiguities, mistakes and inconsistencies in specifications and drawings
40	0.482*	Changes in the scope of the project

PDF: Project Delay Factor
LF: Loading Factor value
* Non-significant Loading Factor

The SEC projects focused on in this research were highly capital intensive and involved the use of an advanced range of technologies which aimed to generate, transmit and distribute electricity to different users around the Kingdom.

Rapidly developing equipment technologies presented an opportunity for the SEC to support its aging infrastructure with innovative solutions. This also presented an opportunity for the Contractors and suppliers to sell a wider range of products to the SEC with varying features. These developing technology products coupled with the potential depth of the contractual details of the required activities and the procured deliverables, made the nature of the binding contract between the SEC and the Contractors progressive rather than completely set and clear. When asked how clear the contracts were with the SEC, AJ (Contractor) stated:

> Contracts are normally broadly clear. But when it comes to jobs of free-issue items from the client, what the status is of these free issue items, what the condition is of the free issue items becomes a question mark. Sometimes the client asks to check their transformer specs from their stores (to procure the same transformers) which might be very old, or they might not even be worth using but they still insist on using it. So there, the clarity becomes a big question but with normal standard projects we know what the client wants.

6.9.1 PDF 41 ('Ambiguities, mistakes and inconsistencies in specifications and drawings')

Of relevance to project contract clarity, this PDF was concerned with repetitive mistakes, ambiguities and inconsistencies in the specifications and drawings in the bidding package. Since the bidding package subsequently became a binding Contract between the SEC and the Contractor, clarity was a crucial ingredient for maintaining a contractual relationship with minimal disputes. This PDF had the largest loading factor value which contributed to the 'Lack of Project Requirements Clarity' Principal Component (Sig. = 0.629). It was also ranked highly by the SEC and Contractor PMs (ranked 5th and 9th, respectively).

HM (SEC) asserted the necessity of having a clear project contract:

> If we make our scope and specifications and drawings, quantities, approved manufacturers and suppliers list, if we make all these crystal-clear we make our lives in projects easier. The clearer we are the better.

But, in reality, contract projects with the SEC were not perfectly clear, as ASAL (SEC) said:

> The specifications can't always be clear; there must be a degree of vagueness.

The researcher was concerned by the fact that, collectively, the SEC had over five decades of project experience and yet the problem of having ambiguous project contracts was persistent. It was understandable that not all project deliverables, especially the auxiliary items, could be addressed before the award of the project. Doing this would have taken a very long time when the need to kick off the project was a matter of high urgency for the SEC. This was in addition to the volatile economic conditions affecting material and equipment prices. The SEC's behaviour towards the Contractors in requesting that they procure equipment with overly engineered technical features was noticeable. Overly engineered equipment features indicated the choosing of desired specifications from several standards from various electrical and electronics institutions and associations. This behaviour was developing before the establishment of the SEC.

6.9.2 PDF 40 ('Changes in the scope of the project')

Project scope change represented a major change in project requirement (such as the addition of a large transformer or the replacement of an old fire fighting system, etc.). This entailed the need to issue a change order to compensate the Contractor, indicating additional financial resources were required. This PDF was only highly ranked by the PD PMs (ranked 9th) and had a non-significant loading factor which contributed to the Principal Component of 'Lack of Project Requirements Clarity' (Loading Factor = 0.482 < 0.512). Quantitatively, this PDF was disregarded as an element belonging to this Principal Component. Qualitatively, changes in the project scope indeed had a significant impact on the project delivery progress and caused serious activity disruptions.

6.10 Concluding Remarks – the Developed Conceptual Model

In the search for the Project Implementation Challenges facing the electricity supply industry in Saudi Arabia, this chapter presented the identified PICs and their features and characteristics that were left implicit and unquestioned. This section simplifies the exhibited conceptual model of the PICs and their main PDF elements. The study has identified 7 PICs that were constructed with the 28 highly ranked PDFs. These PICs and their corresponding PDFs were:

1. SEC's Contractual Commitments:

    - Delay in progress payments by the SEC

- Delay in the settlement of contractor claims by the SEC
- SEC being uncooperative with the contractor, complicating contract administration
- Suspension of work by the SEC
- Delay in furnishing and delivering the site to the contractor by the SEC
- Delay in issuance of change orders by the SEC
- Slow decision making by the SEC
- Difficulties in financing the project by the contractor

2. SEC’s Communication and Coordination Effectiveness
    - SEC’s failure to coordinate with government authorities during planning
    - SEC’s poor communication with related government authorities
    - SEC’s poor coordination with contractors and consultants during project execution
    - SEC’s poor coordination with the various parties during project execution
    - Difficulties in obtaining work permits

3. Contractor's Project Planning and Controlling Effectiveness

   - No effective or realistic contingency plans in case the project is behind schedule or over budget
   - Ineffective planning and scheduling of the project by the contractor
   - Ineffective control of the project's progress by the contractor
   - Improper technical study by the contractor during the bidding stage
   - Delay in materials delivery

4. Consultant-related

   - Delay in the approval of contractor submission by the engineer
   - Slow response from the consultant engineer to contractor inquiries
   - Delay in performing inspection and testing by the consultant engineer
   - Poor communication between the consultant engineer and other parties involved

5. Manpower Challenges and Materials Uncertainties

   - Low manpower skills
   - Changes in material prices
   - Shortage of manpower

6. SEC's Tendering System

7. Lack of Project Requirements Clarity

- Ambiguities, mistakes and inconsistencies in specifications and drawings
- Changes in the scope of the project

After presenting the conceptually modelled PICs and describing the complexities of, and the relationships with, their PDFs, the next chapter will discuss the revealed findings in comparison with the reviewed literature.

7. Project Implementation Challenges in Context – Discussion of Findings

7.1 Introduction

The previous chapter showed that the SEC, as the Project Owner, was directly relevant to most of the PICs identified in the investigated industry. These PICs were SEC's Contractual Commitment, SEC's Communication and Coordination Effectiveness, SEC's Tendering System and Lack of Project Requirements Clarity, and they had 17.58%, 12.88%, 5.01% and 5.01% of total variances explained, respectively. Collectively, the SEC-relevant PICs accounted for 40.48% of total variance explained. The following examined how the SEC-related Project Implementation Challenges were interconnected and how they affected Contractor- and Consultant-related Project Implementation Challenges. These will be compared with the literature review findings.

7.2 SEC's Contractual Commitment

Strong project commitment by the project owner was identified as one of the most important factors for project success (Anderson *et al*., 2006). In this study, SEC's Contractual Commitment represented the most significant PIC. This PIC was concerned with the SEC contractual obligations and duties with various project shareholders. Most of the PDF studies, including this one, confirmed the persistent delay in the progress payments made by the owners to the Contractors (Al-Kharashi and Skitmore, 2009, Arditi et al., 1985, Assaf and Al-Hejji, 2006, Odeh and Battaineh, 2002). In this study, only Contractor PMs ranked this PDF highly (ranked 8th) since it directly affected their organisational resource management. The situation, however, was much improved since the establishment of the SEC. Previously, the normal practice in SCECOs (Saudi Consolidated Electricity Companies) was to authorise urgent projects without proper allocation of the required funds. This led to significant delays and prolonged disputes with Contractors when their payments were due. The problem was now more relevant to approving the Contractor's invoices in a timely manner since this seemed to be time-consuming. This resulted from a slow decision-making process in addition to the rigid requirements observed by the SEC Finance Department in reviewing the invoices.

The delay in the settlement of Contractor claims by project Owners was also common in the PDF studies (Zaneldin, 2006, Al-Kharashi and Skitmore, 2009, Faridi and El-Sayegh, 2006). In this study, only Contractor PMs highly ranked this PDF (ranked 10th) as the SEC delayed decisions relevant to financial compensation or time-extension requests submitted by these PMs. Rejecting claims, especially the justifiable ones, led to Contractors perceiving project owners to be uncooperative, which complicated the contract administration (Al-Kharashi and Skitmore, 2009, Mezher and Tawil, 1998, Odeh and Battaineh, 2002).

Suspension of project works by project Owners was also a serious factor contributing to project delay (Al-Kharashi and Skitmore, 2009, Chan and Kumaraswamy, 1997). In this study, this PDF was in the form of, for example, not arranging necessary shutdowns to integrate the final project product into the SEC's power system, interruptions by public authorities with other project plans, or public neighbourhoods not wishing to live near to power substations equipped with high-voltage transformers. The latter showed the importance of securing public acceptance at the project planning stage, as detailed in Loring's study (Loring, 2007). The real problem, though, was the authorities not having in place relevant public inquiry legislation. These projects were awarded to Contractors and work permits were issued and yet there were further interruptions led by the public.

Delaying the delivery of the project site to the awarded Contractors was also noticed in the PDF studies (Al-Kharashi and Skitmore, 2009, Chan and Kumaraswamy, 1997). The SEC also faced difficulties in handing over the project site to the awarded Contractor, which delayed mobilization of the procured equipment, materials and manpower to initiate the project works. This was especially true when the project site was owned by the Municipality. The example presented in this study was relevant to the avoidance of signing the tenancy contract, which caused serious project work interruptions by delaying the issuance of necessary project work permits.

Change orders were also very serious and common PDFs in several construction industries (Arditi et al., 1985, Assaf and Al-Hejji, 2006, Chan and Kumaraswamy, 1997, Sweis et al., 2008, Koushki et al., 2005). In this study's context, change orders were reasons for many avoidable flaws, including the obvious lack of conducting comprehensive reviews of the SEC bidding package by the Specifications and Design Department engineers. This also clearly reflected the poor coordination with the SEC's internal Departments. The Project Proponent Department, for example, would notice that necessary deliverables were not included in the contract during the project construction. Depending on their values, issuance of change orders required approvals from the SEC Top Management to compensate the Contractors for procuring the additional deliverables. Therefore, in addition to the slow decision-making process in the SEC, change orders implied that additional financial enforcements were required. Financial resources, however, were proven to be very scarce. Therefore, the SEC representatives attempted, in some cases, to persuade Contractors to procure the additional deliverables at no cost. If these additional deliverables were discussed during the offer analysis with the lowest bidder, the Bid Review and Evaluation Team members would establish negotiations with the second lowest bidder if the lowest bidder refused to procure these deliverables.

Slow project decision making by project Owners was also highly regarded in the PDF studies (Al-Kharashi and Skitmore, 2009, Arditi et al., 1985, Chan and Kumaraswamy, 1997, Faridi and El-Sayegh, 2006, Mezher and Tawil, 1998). In addition to the many signatures required to validate the decision, slow decision making indicated a serious lack of authority by the project team members (Sense, 2008). In this study, many SEC PMs complained of a lack of authority. This was evident when some PMs mentioned cases where trivial issues that could have been quite easily resolved by them because they knew what the normal practice and action was that needed to be taken; yet, due to their lack of authority, however, trivial issues could escalate into more serious ones which, sometimes, required other departments to make decisions on. Therefore, there is a genuine need to have in place a well-structured strategy to empower these PMs to make project decisions (Williams, 1997).

Project overload referred to managing projects beyond the PM's capable capacity (Zika-Viktorsson *et al*., 2006). As a result, this would minimise his project control abilities. This was indeed becoming a phenomenon in the SEC. As was mentioned before, the researcher interviewed ORFA (SEC), who was managing four projects simultaneously. After two years, the researcher learned from ORFA (SEC) that he was managing 9 or 10 projects at a time. Five of these were in the closure phase. Projects under closure were described by SAR (SEC Contract Manager) as “hectic”. Consequently, ORFA (SEC) felt ‘lost’ in many cases. On the other hand, JAWI (SEC) thought that a PM should manage only one project. In other words, he found it difficult to manage more than one project at a time. Although he was managing 6 projects simultaneously, his claim presented the problem of comprehending the limits of project overload. Clearly, maintaining the SEC’s contractual commitments was challenging, not only with external organisations such as the Contractors and Municipalities, but also with its project employees.

7.3 SEC’s Communication and Coordination Effectiveness

Maintaining effective communication and coordination with the relevant project stakeholders is an essential means for minimising project uncertainties (Jha and Iyer, 2007, Bentley and Rafferty, 1992). The SEC dealt with various project stakeholders, and they needed reliable information concerned with the project in a timely manner. Therefore, this PIC could be considered as one form of the SEC’s Contractual Commitments. However, having the communication- and coordination-related PDFs grouped in one Principal Component indicated the significance of this PIC and so needed to be addressed separately. This observation was consistent with the PDF studies that considered project communication between the stakeholders to be a serious concern (Alaghbari et al., 2007, Arditi et al., 1985, Mezher and Tawil, 1998, Clarke, 1999, Pinto, 1990). Project communication represented the generation, collection, distribution and retrieval of project information (PMI, 2004), and project coordination indicated the harmonizing and integrating of project activities or requirements between the project parties (Jha and Iyer, 2006). The SEC Project Planning Department presented a serious shortcoming with regards to performing necessary coordination with the relevant government authorities during the project inception phase. This led to difficulties during project construction. For example, lack of information about the project site conditions caused the changing of the cable route during construction. This was consistent with Chan and Kumaraswamy's study (Chan and Kumaraswamy, 1997). Poor communication also contributed to the difficulty of obtaining project work permits during project execution, as in Al-Khalil and Al-Ghafly's study (Al-Khalil and Al-Ghafly, 1999b). At the time of this research study, the SEC had shifted the responsibility of issuing project work permits to Contractors since government authorities were perceived as being very difficult to manage and did not cooperate with the SEC in a timely manner. Yet, even when these permits were finally issued, projects were interrupted by the same authorities who issued the permits in the first place. Project contractors, in some cases, needed the SEC's support to issue the necessary project permits using means more effective than just writing letters. The SEC PMs, on the other hand, presented a lack of project ownership attitude when a few PMs claimed that to personally meet the authorities' representatives was beyond their job scope.

The project overload that each PM experienced contributed to ineffective coordination and less frequent communication by the SEC PMs, especially with the Contractor and Consultant PMs. In fact, having frequent communication and effective coordination between the SEC Departments and sometimes within the same Division presented a central challenge for the SEC. For example, WALA (SEC) complained about not having a clear project organisation structure representing the SEC, while the Contractor was required by the SEC itself to provide its project organisation chart. He struggled as a PM to know who he should contact in the SEC Departments or Divisions. The Company lacked, at the time, an internal directory. This problem became acute, for example, when SEC PMs had to arrange for project equipment testing and commissioning with the Project Proponent Department.

To a great extent, the SEC had a rigid and highly centralised organisational structure. For example, the Engineering and Projects business sector of the Power Generation activities oversaw all SEC projects, from Riyadh in the Central Operating Area to the Western, Eastern, and Southern Operating Areas. Each of these operating areas had three departments - Project Planning, Project Specifications and Design and Project Execution - that reported back to the Engineering and Projects business sector. This, as a consequence, played a key role in the SECs slow decision making discussed previously, especially those relevant to issuing project change orders when additional financial enforcements were normally required.

7.4 SEC's Tendering System

This challenge revealed a unique and perfect agreement between the SEC and Contractor PMs, who both ranked this PDF highest. In fact, this PDF was statistically eligible to form a Principal Component on its own. There were a few relevant issues that supported the significance of this PIC, including:

1) Although participants representing the SEC Contracting Department claimed to have a sound prequalification system, the adopted system was surrounded by noticeable weaknesses. Prequalifying the Contractors was necessary to screen out Contractors with inadequate resources or relevant experience (Al-Reshaid and Kartam, 2005). Therefore, not inviting such

Contractors was in the SEC's interest since it would avoid potential problems with these Contractors. In general, most of the SEC qualified Contractors were experienced. However, the Contracting business volumes were continuously growing, in the SEC, specifically, and in other public projects, in general. This presented two serious risks for the SEC. The first was the SEC being forced to award projects to Contractors known to have inadequate resources to carry out the activities. The second risk was the pressure on the SEC to qualify more new Contractors whose experiences were in delivering public projects. These collectively contributed to project delays and troubles in the industry. Clearly, although the prequalification system was supposed to provide the project owner with a reliable method to select contractors that were capable of carrying out the project activities (El-Sawalhi *et al*., 2007), various external forces prevented the SEC from making efficient usage of the system.

2) Bidding package arrangement is the most critical stage in projects (Ling and Poh, 2008). This was also sensed in the SEC projects when several flaws at this stage evidently contributed to various forms of delay in these projects. The Specifications and Design engineers, for example, had poor coordination and did not conduct comprehensive reviews of the bidding packages. This prolonged the tendering project stage and, in addition, was the cause of chaotic problems that appeared during project execution. ABAB (SEC) presented to the researcher evidence that the Specifications and Design Department requested that the Project Execution Department provide them with the lessons learned in previous projects in order to avoid repeating the same mistakes in their bidding packages. SAR (SEC), on the

other hand, gave other evidence that these lessons were not taken seriously.

3) The SEC behaviour during the bid offer analysis raised concerns. One of the relevant bidding package flaws was the missing of some essential deliverables. In some cases, these deliverables were noticed by the Bid Review Evaluation Team (BRET) during the lowest bidder offer analysis. To avoid issuing a change order and perhaps the necessity to repeat the tendering process, the BRET tended to persuade the lowest bidder to accept procuring these deliverables at no additional cost. In most cases, the lowest bidders accepted procuring these deliverables after strong and abusive pressure was applied by the BRET. This presented an opportunity for the lowest bidder. There were most likely other necessary missed deliverables that would be noticed during project construction. Therefore, missing these deliverables would inevitably force the SEC to issue change orders. In fact, Mohamed *et al*. (2010) argued that awarded Contractors might have lowered their bid prices and sacrificed any profits in the hope of recovering these profits when the inevitable change orders arose (Mohamed *et al*., 2010). SAR (SEC) described how Contractors were only in a stronger position than the SEC when his organisation was forced to issue a change order. This was true since the change order prices for the new deliverables were not usually negotiable. This opportunistic behaviour could have been avoided, or at least minimised, if the SEC had effectively learned from previous projects and, more importantly, had used fair tendering behaviour.

7.5 Lack of Project Requirements Clarity

This PIC was highly relevant to the flaws identified during project tendering. These flaws contributed to placing change orders for additional deliverables. The issuing of change orders was also identified in other construction industries as a persistent problem (Arditi et al., 1985, Assaf and Al-Hejji, 2006, Chan and Kumaraswamy, 1997, Kaming et al., 1997, Sweis et al., 2008, Koushki et al., 2005). Moreover, the SEC contracts were of a developing nature. Therefore, not all project deliverables were specified. Both NABA (SEC) and AJ (Contractor) agreed that these non-specified deliverables were a source of concern during project construction. These deliverables triggered both the SEC and Contractors to interpret the contract differently based on their interests. This was besides the noticeable lack of required information with regards to the technical limitations of the project site. Information availability was a serious problem, especially in expansion projects. Even worse, the information provided to the Contractor was, in many cases, inaccurate. For example, the site conditions differed from those described in the bidding packages. This indicated that additional and necessary change orders were required. The project site locations were also changing during the bidder offer analysis, while the bidders based their offers on a different location and, hence, with different conditions.

8. Research Conclusions and Implications

8.1 Introduction

This problem-driven research study aimed to develop a coherent understanding of the Project Implementation Challenges to improve the project delivery rate of the Saudi Arabian electricity supply industry. The conducted study adopted both a pragmatic and a theoretical approach by triangulating literature, a questionnaire survey and semi-structured interviews to formulate the factors delaying project delivery in the investigated industry. These were then arranged to form the Project Implementation Challenges. This chapter will present, for each research objective, what was looked for, what was found and the significance of these findings. This will be followed by recommending remedial practices that aim to minimise the effect of the presented findings. However, it is crucial to acknowledge that these recommendations are not necessarily offering sustainable solutions for the troubled investigated industry. This is because the suggested practices are based on serious problems identified in a highly sensitive industry with an apparent political visibility. Therefore, the identified challenges will naturally develop based on key stakeholders' actions which are taking place while this report is being written. Thus, the presented solutions and recommendations are circumstantial rather than sustainable. To provide practical suggestions to improve the general state of the industry in a sustainable manner, it is essential to devote resources coupled with sincere willingness by the key stakeholders, especially the government, to provide the essential sustainable solutions for the industry as a whole with detailed plans of actions for each stakeholder to follow and enforce.

8.2 Addressing the Saudi Arabian Power Industry Challenges – general view

The first two objectives of this research were to develop a coherent understanding of the challenges surrounding the Saudi electricity industry as a whole, followed by documenting the industry-related adopted polices to assess their role in the existence of these identified industrial challenges. The challenges surrounding the Saudi electricity industry as a whole were:

- Acceleration of Saudi Arabian domestic demand for electricity at a very fast rate of 8% annually when the world electricity demand was averaged to increase at a rate of 2.5% annually.

- Inefficient usage and thus wastage of electricity promoted by the heavy subsidies adopted by the government in addition to allowing the importing of cheap and inefficient electrical appliances.

- The requirement to make substantial investments in order to secure additional electricity supplies in addition to the need to replace the aging infrastructure. It was forecasted that by 2032 Saudi Arabia would be required to triple the existing generation capacity to secure sufficient supplies. This forecast presented two central problems for the government. The first was the projection of the likely need to burn more oil as its use as the primary fuel for power plants would increase significantly. This indicated that the oil available for exports is likely to decline while global demand for oil is likely to increase. Knowing that revenue from oil exports is a fundamental source of income for the government presents complex political, economic and social challenges.

The second central problem was the lack of sufficient financial resources required to authorise urgent expansive projects in the Power Supply Industry.

The second research objective overlapped in nature with the first objective described above. However, this research was able to develop a thorough understanding of the reasons preventing the enforcement of necessary reforms. For example, the government showed a reluctance to fully invest in the highly intensive industry. It had already offered subsidies in the past that gradually increased, and seemed to resist an adjustment of the tariff that would promote both efficient electricity usage and create new financial channels for new investments in the Power Supply Industry. The government was highly influenced by domestic socio-political forces when it reduced the, seemingly, commercial tariff introduced by the SEC in less than a year after the start of its operation in 2000. The fact that the government adjusted the tariff without providing a coherent compensation scheme for the SEC reduced its revenues significantly. The consequences of this were as follows:

- Delay in the execution of several planned power generation, transmission and distribution projects, including the inability to generate reserve margins during peak loads and to adequately replace aged infrastructure.
- The urgency of authorising expansive projects in the industry forced the SEC to rush a bid in once the financial resources were finally allocated. This resulted in poor preparation of the bidding package documents due to their being arranged within a tight time scale. The negative consequences could have been minimised if the financial resources were allocated and released in a timely manner.

- Authorisation of extremely urgent projects on 'super-rush' bases has become more common in the industry. These projects were awarded to specific Contractors through direct negotiation to significantly reduce the necessary time-consuming project tendering process. These Contractors were chosen based on selective criteria. This, however, represented additional financial burdens when considering the premium charges of these projects. One of the recent projects was awarded to a local Contractor in January 2010 by the SEC for the expansion of the Al-Qassem Power Plant; the project brief was to supply, install and commission four gas turbines for the existing facility in just six months (BMI, 2010). This followed the extreme inconvenience caused by the frequent electricity interruptions in the summer of 2009. The project was successfully delivered on time just before the summer of 2010 when the demand for electricity was expected to peak again but with sufficient supplies.

The main implication of the research was identifying a serious and central problem facing the industry, which was the lack of vision. This basic need for any industry must be articulated by the government. The central purpose of the government is to protect and promote the economic and social well-being of its people (OECD, 1997). Therefore, its actions remain crucial for addressing the various challenges surrounding the society. Although the consequent problems resulting from the adopted domestic energy policies were foreseen years before, they were not addressed until they became acute, leading to severe additional costs. The slow-decision making towards viable solutions significantly reduced their validity because other problems were created. For example, members of the Gulf Council Countries (including Saudi Arabia, the most influential member) discussed the integration of the countries' transmission grid for over 20 years before the establishment of the GCC Interconnection Authority in April 2002. The three-phase project is due to begin operation in 2011. If this project had begun operation years earlier, peak load problems in both the Eastern and Central Operating Areas (since these are both interconnected) would have been better managed. This is because, for example, instead of building more power plants in either of these two areas, electricity could have been imported from these neighbour states when needed. Moreover, some relevant entities revealed a worrying level of ambiguity in their roles. For example, the Ministry of Water and Electricity was, allegedly, responsible for establishing the overall policy plans and strategies for the industry. Similarly, the Electricity Cogeneration Regulatory Authority (ECRA) was planning strategies for reforming the electricity industry. However, both the MWE and ECRA did not have sufficient authority to implement these policies and strategies sustainably. In many cases, the centralised authority of the Council of Ministers caused interruptions to the industrial reform plans. Its interventions, along with the reluctance to phase-out the industry tariff subsidies, were not compatible with the industry privatisation initiative. It is crucial, however, to acknowledge that reforming the industry is likely to require holistic reforms in other aspects of the economy. Tangible reforms in commercial and civil laws, for example, will attract the private sector, whether local or international, to invest in the industry. Moreover, these holistic reforms will improve the incomes of individuals and enterprises, and they will, therefore, accept having to pay for their energy consumption with cost-reflective tariffs.

Saudi Arabia is adopting a thermal reliant policy with intensive and increasing usage of its natural and depleting resources. The recent constraints in gas supplies, coupled with increasing usage of Heavy Fuel Oil to power the generating plants, have raised some genuine concerns. The highly subsidised electricity service has led to increases in electricity demand and inefficient usage, while the investment in the industry seems very demanding financially when compared to its national economy contribution. The electricity sector has proven to require adequate and timely but substantial investments in its infrastructures. Transforming the public utility into a competitive market has been an option for a long time. However, this entails a cost-reflective electricity price which seems a desirable but painful option. These concerns must be addressed with a comprehensive and, most importantly, credible policy to rectify the domestic energy demand projections and secure adequate supplies. The researcher is concerned that with the lack of having comprehensive and transparent plans, in addition to the reluctance to explicitly announce steps for the gradual phase-out of subsidies, the private sector will not be completely attracted to the idea of investment in the industry as the risks of a non-comprehensive policy remain high for the investors. A comprehensive energy policy should also set clear targets and deadlines to meet with explicit mechanisms for how the required relevant investments would be financed.

8.3 The Saudi Arabian Power Supply Project Challenges: From Project Delay Factors to Project Implementation Challenges

The last research objective was to conduct a comprehensive analysis of the project management practice in the Saudi Arabian power supply industry and present the significant factors contributing to project delay as perceived by the project practitioners. The study was confined to authorised turnkey projects, where relevant funds are already allocated, which must be executed in a timely manner to meet, at least partially, the country's need for electricity.

Fifty eight selected PDFs were surveyed to rate the importance levels of each according to Project Managers who had experienced managing the investigated industry's projects. This was achieved by assigning numerical values that represented the weights of the investigated PDFs' importance. These weights were examined according to respondent groups' collective experiences. Applying importance ranking analysis determined which of these were more important and which were less important. For the purpose of this research, the highly ranked PDFs were those among the highest 10 PDF importance index values according to the SEC, Contractor, Consultant, Power Generation, Power Transmission or Power Distribution Project Managers. Collectively, these amounted to 28 PDFs and were considered the most important PDFs. It was noted that both the SEC and Contractor PMs considered the PDF **'SEC's tendering system requirement of selecting the lowest bidder'** the most important PDF. On the other hand, Consultant PMs had not even considered this PDF among their highly ranked ones (i.e. among their top ten PDFs). The 58 PDFs were also subjectively classified into different groups and were ranked according to the SEC, Contractor and Consultant PMs. The highlighted results were those relevant to organisational responsibility PDF groups. Both the SEC and Consultant PMs ranked the SEC-related PDFs highest. Consultant PMs ranked Consultant-related PDFs 2nd. Contractor PMs also agreed with the other two PM groups who ranked the SEC-related PDFs 2nd. They also ranked the Consultant-related PDFs group highest. This has legitimately concluded that the three respondent groups were, in general, not biased, although they represented different organisations with varying interests in projects. Moreover, Consultant PMs ranked the Communication-related PDFs group highest, while both the SEC and Contractor PMs ranked the same group of PDFs 8th.

The use of Ranking analyses along with Spearman Rank Correlation Coefficients to understand the agreement levels between the respondent groups were not sufficient to comprehend how these highly ranked PDFs were perceived. Factor Analysis was used for this purpose and structured these PDFs in a meaningful set of Principal Components. These Principal Components eventually constructed a conceptual model where the Project Implementation Challenges were identified. The significance of these Project Implementation Challenges (PICs) was in being composed from the 28 most important PDFs identified previously using the conducted Ranking analyses. Each of these 28 PDFs was at least among the ten most important PDFs according to the SEC, Contractor, Consultant, Power Generation, Power Transmission or Power Distribution project managers. Eventually, applying Factor Analysis to these PDFs suggested the following Project Implementation Challenges:

8.3.1 The Saudi Electricity Company's Contractual Commitment

The most significant Project Implementation Challenge in the investigated industry was the SEC's ability to commit to its contractual obligations and duties with its Contractors. The researcher argues that for the SEC to be able to meet its project contractual obligations with its Contractors and, most importantly, to its service users, the SEC needs to meet its obligations with its employees, the most valuable asset in the organisation, by providing a working environment that promotes maximum productivity. There are many areas where the SEC can indeed provide even more in this particular aspect.

The researcher argues that the heart of the problem which contributed to the development of the most significant Project Implementation Challenge identified in this study – SEC's Contractual Commitment - was project management not being treated as a professional and, most importantly, a strategic discipline. A professional discipline requires a well-structured and sound formal approach where official processes and tools are put in place for effective and efficient management. This was not the case in the SEC where many PMs referred to this problem. The lack of such basic infrastructure resulted in poor project management practice which, in this study's context, significantly contributed to delaying project delivery and closure. The challenge is compounded by the fact that this poor project management practice developed continuously over many decades before the establishment of the SEC. In other words, poor project management practice has become an industry trend and an acceptable phenomenon. There is little indication of change occurring.

The establishment of the Project Management Office (PMO) in the SEC is valued as an urgently required capital investment that would directly serve to meet the SEC's vision and mission. A PMO is

> An organizational unit to centralize and coordinate the management of projects under its domain…its responsibilities can range from providing project management support functions in the form of training, software, standardized policies, and procedures, to actual direct management and responsibility for achieving the project objectives.
>
> (PMI, 2008)

Industry knowledge of PMO is still sketchy (Pellegrinelli and Garagna, 2009). However, the potential behind establishing a PMO in the SEC should never be underestimated. In the SEC's context, where the culture is highly rigid, the establishment of a PMO would face immense resistance, and this was identified as a top challenge in other cultures (Singh *et al*., 2009). This is especially true in a "very" busy organisation that is overloaded with many projects where time is of the essence. Therefore, any proposal for change would be perceived as a waste of the scarce resource of time. The researcher strongly recommends securing the support of the

SEC's Top Management to establish a PMO managed by experienced senior project managers. Its establishment should take place in the most supportive business sector whose executives can champion the concept while working directly under the Engineering and Projects Executive Director (i.e. either in Power Generation, Power Transmission or Power Distribution sector). Its basic infrastructure would be comprised of human resources and relevant policies, standards, tools and techniques. It may start directing, for example, 25% of Power Transmission Projects in the Western Operating Area where it would dissolve the solid barriers between the Project Planning, Project Specifications and Design and Project Execution Departments into one collective team pulled from their original departments. There should be explicit and clear performance indicators of the PMO to maintain its prosperity.

8.3.2 The Saudi Electricity Company's Communication and Coordination

The above recommendations would certainly improve the SEC's underdeveloped management areas across various departments. However, the next Project Implementation Challenge – SEC's Coordination and Communication Effectiveness - proved that the SEC was facing serious difficulties in managing its internal stakeholders, such as the Project Proponent Department (Generation Operations in the Western Operating Area, for example), Finance Department, Contracting Department, Industrial Security Department and other internal project stakeholders. In some cases, the government authorities, and sometimes the public, also caused the relocation of project sites after the project had been awarded to the Contractor. After conducting the lengthy tendering process, project site relocation was a source of severe inconvenience for both the SEC and Contractors' resource management.

An Enterprise Resource Planning system is a very powerful tool since it can provide a high degree of cross-functional integration across different departments. Since late 2007, the SEC has operated an ERP system, but it has been limited to Human Resource applications (SEC, 2007). This is perceived as a convenient opportunity where the suggested PMO, assuming it already provided a well-structured and formal project approach and process that promoted rich project communications, could embrace an upgrade to this powerful ERP tool for project management purposes. This would definitely enhance the coordination effectiveness between the SEC departments.

The SEC also needs to consider hiring and training employees to manage issues related to the government authorities, such as knowing about future project plans which could potentially disrupt or support the SEC's project plans in their inception phase. Therefore, a well-informed decision with regards to selecting a convenient project site location could be made with minimal disruption and inconvenience. There also needs to be management of public concern when the SEC plans to build, for example, a substation in a residential area and risk assessments need to be conducted to determine whether or not the SEC is likely to face any problems.

8.3.3 SEC's Tendering System

The research pointed out several areas where the SEC tendering system needs serious development. However, applying the above recommendations would have a positive impact on the SEC's current practice. This positive impact would include the following:

- The involvement of the SEC assigned PM during the bidding package arrangement is crucial to minimise the level of project uncertainties. In addition to being informed of all correspondence and updates during this critical stage, a PM's experience in similar projects will enable him to address potential problems before awarding the project to the potential Contractor.

- Never tender before arranging the site location. Contractors frequently need to extend the bid deadlines as a result of relocating the project site.

- Improve the prequalification system by preventing qualified Contractors with stretched resources from bidding. Although the lack of available resources is a phenomenon in Saudi Arabian public projects, the researcher strongly suggests drawing up a strategy to attract sound international Contractors to invest in the SEC projects. The recently published World Investment Report in July 2010 by the UN Conference on Trade and Development placed the Kingdom of Saudi Arabia among the top 10 most attractive countries in the world for Foreign Direct Investment in 2009 (ranked 8th globally) (UN, 2010). This must be treated as an opportunity to attract more and sound foreign Contractors. Therefore, improving the SEC's project management practice, especially towards meeting its contractual commitments and obligations, would minimise the business risks for these contractors.

- Avoid forcing the lowest bidder to commit to procuring deliverables beyond the original bidding requirements just before awarding the project.

- The two-envelope tendering system adopted in the Power Generation projects is very time consuming since only bidders with accepted technical offers are requested to submit their financial offers. However, this system was not perceived to be among the highly ranked PDFs by Power Generation PMs, which indicated its positive impact on project construction progress. The researcher is concerned about the movement towards reinforcing the older one-envelope tendering system by the SEC Top Management, which was perceived by both Power Transmission and Power Distribution PMs as one of the most important project delay factors. This indicated that although this tendering system was perceived as less time-consuming, the overall impact was strongly considered by PMs as a main concern, especially in the project construction phase. Therefore, the researcher recommends a thorough and holistic assessment and evaluation of the potential impacts of re-applying the one-envelope tendering system in Power Generation projects. Submitting comprehensive reports on these impacts may influence the SEC Top Management decision.

8.3.4 Lack of Project Requirements Clarity

This mainly referred to changes in project scopes during execution as a result of the developing nature of the SEC's contracts since not all project deliverables were specified, in addition to the recurrent mistakes and inconsistencies found in the bidding documents. However**,** the previously suggested recommendations, especially relevant to establishment of the PMO, would promote a learning environment and improve the SEC's Specifications and Design engineers' skills and practices. Therefore, the usual inconsistencies, mistakes and ambiguities found in the bidding packages would be minimised. Moreover, the PMO officers would involve all relevant stakeholders, especially the Project Proponent, during the preparation of the bidding package and securing of the signed consent and approval for the project deliverables. This would minimise disruption of the progress of the project as a result of placing additional change orders during the project execution phase. For example, a Contractor PM was frustrated when the Industrial Security Department modified its fire fighting system specifications in 2007 after his project was awarded and began execution in 2006. The Industrial Security Department of the SEC insisted on applying the modifications on the ongoing project, which of course, had further inconvenient consequences. This could be avoided through the suggested PMO, which would secure the consent of all relevant stakeholders not to change the project's specifications, at least on ongoing projects. The PMO would also conduct a comprehensive project requirement study to distinguish between critical deliverables and nice-to-have deliverables. This would certainly lead to less project change orders and indeed to more satisfied SEC Top Management.

8.3.5 Impact on Contractor's Planning and Controlling Effectiveness and Consultant-related Project Implementation Challenges

The recommendations above would present the SEC with strong project commitment, where the internal and external stakeholders would hopefully be managed effectively through rich communication and coordination. Improving the tendering system, where the project requirements are much more clarified, would have a positive impact on the project management practice in the investigated industry. All of these recommendations would resolve the relevant problems of the most pressing Project Implementation Challenges identified in this research and would improve, therefore, the project delivery rate. The SEC being more contractually committed, and with effective communication and coordination initiatives in place in addition to being more consistent and predictable, would have a positive impact on both the Contractor and Consultant project practices. The SEC PMO high standards could force the Contractor, for example, to provide a proactive schedule system instead of the traditional detailed plan prepared once at the project outset without being updated (Alsakini *et al*., 2004). In other words, the SEC PM could demand the Contractor PM, as a project control procedure, to actively update the project plan during execution. This would allow the SEC PM to update the PMO's information system, which would flag the relevant internal stakeholders if they were required to take action through the ERP.

The SEC's strong contractual commitment with its Contractors indicates more predictability with less project uncertainties. The improved project practice would motivate, and probably force, Contractors to invest in their project management systems and project managers. In fact, this could take the competition between Contractors to another challenging level where all would search for applicable and valuable project management tools and processes for best practice. It was noticed in the study that an international Contractor in Saudi Arabia was not investing in their project managers' development. Arguably, the Contractor was not motivated since the project practice was not sound enough, especially from the SEC, the most influential project stakeholder. This, however, could change since the contracting market would be more competitive as a result of the SEC's improved project practice and its consistent prequalification system, assuming more international Contractors entered the market. Moreover, improving the SEC's project requirements by selecting specific technical standards, in addition to minimising bidding package inconsistencies and mistakes, would improve the Consultants’ project practice and their response rate to Contractors’ submittals and approvals.

References

AIBINU, A. & JAGBORO, G. 2002. The effects of construction delays on project delivery in Nigerian construction industry. *International Journal of Project Management,* 20**,** 593-599.

AL-AJLAN, S., AL-IBRAHIM, A., ABDULKHALEQ, M. & ALGHAMDI, F. 2006. Developing sustainable energy policies for electrical energy conversation in Saudi Arabia. *Energy Policy,* 34**,** 1556-1565.

Author. 2010. Ali Al-Barrak: The ongoing pojects are sufficient for only three years. *Aleqtisadiya*, 15 February.

AL-KHALIL, M. & AL-GHAFLY, M. 1999a. Delay in public utility projects in Saudi Arabia. *International Journal of Project Management,* 17**,** 101-106.

AL-KHALIL, M. & AL-GHAFLY, M. 1999b. Important causes of delay in public utility projects in Saudi Arabia. *Construction Management and Economics,* 17**,** 647-655.

AL-KHARASHI, A. & SKITMORE, M. 2009. Causes of delays in Saudi Arabian public sector construction projects. *Construction Management and Economics,* 27**,** 3-23.

AL-MOMANI, A. 2000. Construction delay: a quantitative analysis. *International Journal of Project Management,* 18**,** 51-59.

AL-RESHAID, K. & KARTAM, N. 2005. Design-build pre-qualification and tendering approach for public projects. *International Journal of Project Management,* 23**,** 309-320.

AL-SAQER, K. M. 2001. *An Investigation into the Development Processes and Project Management Practices of Government Construction Projects in Saudi Arabia.* PhD, University of Birmingham.

AL-SEDAIRY, S. 1994. Management of conflict: Public-sector construction in Saudi Arabia. *International Journal of Project Management,* 12**,** 143-151.

ALAGHBARI, W., KADIR, M. A., SALIM, A. & ERNAWATI 2007. The significant factors causing delay of building construction projects in Malaysia. *Engineering, Construction and Architectural Management,* 14**,** 192-206.

Author. 2011. Among the pricipal reasons of their delays: study: 65% of projects in the Kingdom are without project schedule. *Alqtisadiya*, 06 March.

ALKASS, S., MAZEROLLE, M. & HARRIS, F. 1996. Construction delay analysis technique. *Construction Management and Economics,* 14**,** 375-394.

Author. 2010. Saudis keen to address electricity issue. *Financial Times*, January 4, p.11.

ALSAKINI, W., WIKSTROM, K. & KIIRAS, J. 2004. Proactive schedule management of industrial turnkey projects in developing countries. *International Journal of Project Management,* 22**,** 75-85.

ANDERSON, E., BIRCHALL, D., JESSEN, S. & MONEY, A. 2006. Exploring project success. *Baltic Journal of Management,* 1**,** 127-147.

APM 2006. *APM Body of Knowledge*

ARDITI, D., AKAN, G. & GURDAMAR, S. 1985. Reasons for delays in public projects in Turkey. *Construction Management and Economics,* 3**,** 171-181.

ARON, W. 2007. *"Electricity", in McGraw-Hill Encyclopedia of Science & Technology, 10th ed. Vol. 6. New York: Mcgraw-Hill, 2007, pp. 245-247*

ARTTO, K., MATINSUO, M., GEMUNDEN, H. & MURTOARO, J. 2009. Foundations of program management: A bibliometric view. *International Journal of Project Management,* 27**,** 1-18.

ASSAF, S. & AL-HEJJI, S. 2006. Causes of delay in large construction projects. *International Journal of Project Management,* 24**,** 349-357.

ASSAF, S., AL-KHALIL, M. & AL-HAZMI, M. 1995. Causes of delay in large building construction projects. *Journal of Management and Engineering,* 11**,** 45-50.

ATKINSON, R. 1999. Project management: cost, time and quality, two best gusses and a phenomenon, its time to accept other success criteria. *International Journal of Project Management,* 17**,** 337-342.

BACCARINI, D. 1999. The logical framework method for defining project success. *Project Management Journal,* 30**,** 25.

BELASSI, W. & TUKEL, O. 1996. A new framework for determining critical success/failure factors in projects. *International Journal of Project Management,* 14**,** 141-151.

BENTLEY, D. & RAFFERTY, G. 1992. Project Management: Keys to Success. *Civil Engineering,* 62**,** 58.

Author. 2010. Saudis 'comfortable' with oil prices. *Financial Times*, October 12.

BMI 2010a. Saudi Arabia Commercial Banking Report: Includes 5-year forecasts to 2014 Business Monitor International.

BMI 2010b. Saudi Arabia Power Report Q1 2010. Business Monitor.

BP 2010. Statistical Review of World Energy British Petroleum.

BREDILLET, C., YATIM, F. & RUIZ, P. 2010. Project management deployment: The role of cultural factors. *International Journal of Project Management,* 28**,** 183-193.

BREEZE, P. 2005. *Power Generation Technologies,* Oxford, Elsevier.

BROOKES, N. & CLARK, R. 2010. Using maturity models to improve project management practice. Submitted for publication.

CHAN, D. & KUMARASWAMY, M. 1997. A comparative study of causes of time overruns in Hong Kong construction projects. *International Journal of Project Management,* 15**,** 55-63.

CHARMAZ, K. 2008. *Qualititative Psychology: A Practical Guide to Research Methods,* London, Sage.

CIA. 2010. Available: https://www.cia.gov/library/publications/the-world-factbook/geos/sa.html [Accessed 06-July-2010].

CLARKE, A. 1999. A practical use of key success factors to improve the effectiveness of project management. *International Journal of Project Management,* 17**,** 139-145.

CLELAND, D. 1989. Strategic issues in project management *Project Management Journal,* 20**,** 31-39.

CLELAND, D. I. & IRELAND, L. R. 2007. *Project management: strategic design and implementation* New York, McGraw-Hill.

COOKE-DAVIES, T. 2002. The "real" success factors on projects. *International Journal of Project Management,* 20**,** 185-190.

COOKE-DAVIES, T. & ARZYMANOW, A. 2003. The maturity of project management in different industries: an investigation into variations between project management models. *International Journal of Project Management,* 21**,** 471-478.

CRAWFORD, L., HOBBS, B. & TURNER, J. R. 2005. *Project Categorization Systems,* Newton Square, PA, USA, Project Management Institute.

CROWE, A. 2006. *Alpha Project Managers: What the Top 2% Know that Everyone Else Does Not*.

Author. 2010. Back in business: US lifts deepwater drilling ban. *Associated Press*, 12 October.

DANCEY, C. & REIDY, J. 2004. *Statistics Without Maths for Psychology,* Essex, Pearson Education Limited.

DIALLO, A. & THUILLIER, D. 2004. The success dimensions of international development projects: the perception of African project coordinators. *International Journal of Project Management,* 22**,** 19-31.

DVIR, D., LIPOVETSKY, S., SHENHAR, A. & TISHLER, A. 1998. In search of project classification: a non-universal approach to project success factors. *Research Policy,* 27**,** 915-935.

ECRA 2007. Activities and Achievements in 2007 Annual Report. Riyadh: Electricity Co-generation Regulatory Authority.

ECRA 2008. Activities and Achievements 2007. Riyadh: Electricity & Cogeneration Regulatory Authority.

EL-SAWALHI, N., EATON, D. & RUSTOM, R. 2007. Contractor pre-qualification model: State-of-the-art. *International Journal of Project Management,* 25**,** 465-474.

FARIDI, A. & EL-SAYEGH, S. 2006. Significant factors causing delay in the UAE construction industry. *Construction Management and Economics,* 24**,** 1167-1176.

FIELD, A. 2009. *Discovering Statistics Using SPSS,* London, Sage.

FINCH, P. 2003. Applying the Slevin-Pinto project implementation profile to an information systems project. *Project Management Journal,* 34**,** 32.

GRAY, C. F. & LARSON, E. W. 2008. *Project Management: The Managerial Process,* New York, McGraw-Hill/Irwin.

HOFSTEDE, G. 1983. Cultural dimensions for project management *Journal of Project Management,* 1**,** 41-48.

Author. 2010. Deep waters obscure case for oil investment. *Financial Times*, June 25.

HYVARI, I. 2006. Success of projects in different organizational conditions. *Project Management Journal,* 37**,** 31-41.

IBBS, C. & KWAK, Y. 2000. Assessing project management manturity. *Project Management Journal,* 31**,** 32.

IEA 2008. *World Energy Outlook,* Paris, International Enegy Agency.

IEA 2009. *World Energy Outlook,* Paris, International Energy Agency.

JHA, K. & IYER, K. 2006. Critical determinants of project coordination. *International Journal of Project Management,* 24**,** 314-322.

JHA, K. & IYER, K. 2007. Commitment, coordination, competence and the iron triangle *International Journal of Project Management,* 25**,** 527-540.

JUGDEV, K. & MULLER, R. 2005. A retrospective look at our evolving understanding of project success. *Project Management Journal,* 36**,** 19.

JUGDEV, K. & THOMAS, J. 2002. Project management maturity models: The silver bullet of competitive advantage? *Project Management Journal,* 33**,** 4-14.

KAMING, P., OLOMOLAIYE, P., HOLT, G. & HARRIS, F. 1997. Factors influencing construction time and cost overruns on high-rise projects in Indonesia. *Construction Management and Economics,* 15**,** 83-94.

KERZNER, H. 2009. *Project Management: A system approach to planning, scheduling, and controlling,* New Jersey, USA, John Wiley & Sons, Inc.

KFUPM 2006. Updated Generation Planning for the Saudi Electricity Sector. Centre for Engineering Research.

KOUSHKI, P., AL-RASHID, K. & KARTAM, N. 2005. Delays and cost increases in the construction of private residential projects in Kuwait. *Construction Management and Economics,* 23**,** 285-294.

KUMARASWAMY, M. & CHAN, D. 1998. Contributors to construction delays. *Construction Management and Economics,* 16**,** 17-29.

KWAK, Y. & IBBS, C. 2002. Project management process maturity model. *Journal of Management in Engineering***,** 150-155.

LARSON, E. & GRAY, C. 2011. *Project Management: the Managerial Process*, McGraw Hill International.

LIM, C. & MOHAMED, M. 1999. Criteria of project success: an exploratory re-examination. *International Journal of Project Management,* 17**,** 243-248.

LIM, S. & MOHAMED, M. 2000. An exploratory study into recurring construction problems. *International Journal of Project Management,* 18**,** 267-273.

LING, F. & POH, B. 2008. Problems encountered by owners of design-build projects in Singapore. *International Journal of Project Management,* 26**,** 164 - 173.

LONG, N., OGUNLANA, S., QUANG, T. & LAM, K. 2004. Large construction projects in developing countries: a case study from Vietnam. *International Journal of Project Management,* 22**,** 553-561.

LORING, J. 2007. Wind energy planning in England, Wales and Denmark: factors influencing project success. *Energy Policy,* 35**,** 2648-2660.

LYCETT, M., RASSAU, A. & DANSON, J. 2004. Programme management: a critical review. *International Journal of Project Management,* 22**,** 289-299.

MALLAK, L., PATZAK, G. & KURSTED, H. 1991. Satisfying stakeholders for successful project management. *Computers ind. Engng,* 21**,** 429-433.

MAZER, A. 2007. *Electric Power Planning for Regulated and Deregulated Markets,* New Jersey, John Wiley & Sons, Inc.

Author. 2010. Halliburton says BP missed 'red flags'. *Financial Times* September 27.

MEZHER, T. & TAWIL, W. 1998. Causes of delays in the construction industry in Lebanon. *Engineering, Construction and Architectural Management,* 5**,** 252-260.

MIE 2000. *Electricity Development in the Kingdom of Saudi Arabia through 100 years* Riyadh, Ministry of Industry and Electricity.

MIE 2004. *Electricity Growth and Development in the Kingdom of Saudi Arabia 1424/1425H (2004G),* Riyadh, Ministry of Water and Electricity

MOF. 2010. *Saudi Ministry of Finance* [Online]. Available: http://www.mof.gov.sa/en/ [Accessed 27-06-2010].

MOHAMED, K., KHOURY, S. & HAFEZ, S. 2010. Contractor's decision for bid profit reduction within opprtunistic bidding behavior of claims recovery. *International Journal of Project Management*.

MOL. 2010. Available: http://www.mol.gov.sa/ar/AboutMinistry/Pages/ [Accessed 05-July-2010].

MOPM. 2010. Available: http://www.mopm.gov.sa/mopm/detail.do?content=sp_policy [Accessed 27/06/2010].

MORRIS, P. W. G. 1994. *The Management of Projects* London, UK, Thomas Telford

MORRIS, P. W. G. 2009. *Implementing strategy through project management: the importance of the project front-end. In: Williams, T., Samset, K., Sunnevag, K.J. (Eds), Making Essential Choices with Scant Information: Front-End Decision-Making in Major Projects,* Basingstoke, UK, Palgrave Macmillan.

MULLER, R. & TURNER, R. 2007a. The influence of project managers on project success criteria and project success by type. *International Journal of Project Management,* 25**,** 298-309.
MULLER, R. & TURNER, R. 2007b. Matching the project manager's leadership style to project type. *International Journal of Project Management,* 25**,** 21-32.
MUNNS, A. & BJEIRMI, B. 1996. The role of project management in achieving project success. *International Journal of Project Management,* 14**,** 81-87.
NIBLOCK, T. & MALIK, M. 2007. *The Political Economy of Saudi Arabia,* Oxon, Routledge.
NYE, D. E. 2004. *"History of Electricity Use", in Encyclopedia of Energy, Vol. 2, Oxford: Elsevier Inc. 2004, pp.177-190*.
ODEH, A. & BATTAINEH, H. 2002. Causes of construction delay: traditional contracts. *International Journal of Project Management,* 20**,** 67-73.
OECD 1997. The OECD Report on Regulatory Report Synthesis. Paris: The OECD.
OGUNLANA, S. & PROMKUNTONG, K. 1996. Construction delays in a fast-growing economy: comparing Thailand with other economies. *International Journal of Project Management,* 14**,** 37-45.
OPEC. 2010. Available: http://www.opec.org/opec_web/en/about_us/25.htm [Accessed 27/06/2010].
PAYNE, J. H. & TURNER, J. R. 1999. Company-wide project management: the planning and control of programmmes of projects of different type. *International Journal of Project Management,* 17**,** 55-59.
PELLEGRINELLI, S. 2011. What's in a name: Project or programme? *International Journal of Project Management,* 29**,** 232-240.
PELLEGRINELLI, S. & GARAGNA, L. 2009. Towards a conceptualisation of PMOs as agents and subjects of change and renewal. *International Journal of Project Management,* 27**,** 649-656.
Author. 2010. BP kills the spill - but problems remain. *Financial Times*, September 20.
PINTO, J. 1990. Project implementation profile: a tool to aid project tracking and control. *International Journal of Project Management,* 8**,** 173-182.
PINTO, J. & PRESCOTT, J. 1988. Variations in critical success factors over the stages in the project life cycle. *Journal of Management,* 14**,** 5-18.
PINTO, J. & SLEVIN, D. 1988. Critical success factors across the project life cycle. *Project Management Journal,* 19**,** 67.
PINTO, J. K. 2007. *Project Management: achieving competitive advantage* New Jersey Pearson Education, Inc.
PMI 2004. *A Guide to the Project Management Body of Knowledge* USA, Project Management Institue.
PMI 2008. *A Guide to the Project Management Body of Knowledge* USA, Project Management Institue.
Author. 2008. 80% of electrical appliances in Saudi Arabia are not compliant. *Okaz*, 28 October
QSR. 2009. Available: http://www.qsrinternational.com/news_whats-new_detail.aspx?view=153 [Accessed 9-July-2010].
REMENYI, D., WILLIAMS, B., MONEY, A. & SWARTZ, E. 1998. *Doing Research in Business and Management: An Introduction to Process and Method,* London, Sage.
ROBSON, C. 2002. *Real World Research* Oxford, Blackwell.
SAGIA. 2010. *Saudi Arabian General Investment Authority* [Online]. Available: http://www.sagia.gov.sa/ [Accessed 20-06-2010].

SAMBASIVAN, M. & SOON, Y. 2007. Causes and effects of delays in Malaysian construction industry. *International Journal of Project Management,* 25**,** 517-526.
SAUNDERS, M., LEWIS, P. & THORNHILL, A. 2007. *Research Methods for Business Students,* Essex, Pearson Education Ltd.
SEC 2003. The SEC Annual Report.
SEC 2007. Annual Report. Saudi Electricity Company.
SEC 2008. Annual Report 2008: 2020 Ambitious Energy Strategy. Riyadh.
SEC 2009. The Saudi Electricity Company Annual Report 2009: Financial Challenges. Riyadh.
Author. 2010. After the spill: The outlook for crude. *Financial Times*, July 5.
SENSE, A. 2008. The condition of project participants' authority to learn within projects *International Journal of Project Management,* 26**,** 105-111.
SHEHU, Z. & AKINTOYE, A. 2010. Major challenges to the successful implementation and practice of programme management in the construction environment: A critical analysis *International Journal of Project Management* 28**,** 26-39.
SHENHAR, A. 2001. One size does not fit all projects: exploring classical contingency domains. *Management Science,* 47**,** 394.
SHENHAR, A., DVIR, D., LEVY, O. & MALTZ, A. 2001. Project success: a multidimensional strategic concept. *Long Range Planning,* 34**,** 699-725.
SINGH, R., KEIL, M. & KASI, V. 2009. Identifying and overcoming the challenges of implementing a project mangement office. *European Journal of Information Systems,* 18**,** 409-427.
SLEVIN, D. & PINTO, J. 1986. The project implementation profile: new tool for project managers. *Project Management Journal***,** 57-70.
SODERLUND, J. 2004. Building theories of project management: past research, questions for the future. *International Journal of Project Management,* 22**,** 183 - 191.
Author. 2010. Chevron to start UK deepwater drilling *Financial Times*, October 1.
STUMPF, G. 2000. Schedule delay analysis. *Cost Engineering,* 42**,** 32.
SWEIS, G., SWEIS, R., HAMMAD, A. & SHBOUL, A. 2008. Delays in construction projects: The case of Jordan. *International Journal of Project Management,* 26.
THIRY, M. 2005. Speak of success. *PM Network***,** 22.
THOMAS, G. & FERNANDEZ, W. 2008. Success in IT projects: A matter of definition? *International Journal of Project Management,* 26**,** 733-742.
UN 2010. United Nations Conference on Trade and Development: World Investment Report 2010 - Country Factsheet of Saudi Arabia. New York
WILLIAMS, T. 1997. Empowerment vs risk management? *International Journal of Project Management,* 15**,** 219-222.
WILLIAMS, T. 2002. *Modelling Complex Projects,* Chichester, John Wiley & Sons.
WIT, A. D. 1988. Measurement of project success. *International Journal of Project Management,* 6**,** 171-177.
WORLDBANK. 2010. *Population growth rate (annual %)* [Online]. Available: http://data.worldbank.org/country/saudi-arabia [Accessed 14 October 2010].
ZANELDIN, E. 2006. Construction claims in United Arab Emirates: Types, causes, and frequency. *International Journal of Project Management,* 24**,** 453-459.
ZIKA-VIKTORSSON, A., SUNDSTROM, P. & ENGWALL, M. 2006. Project overload: An exploratory study of work and management in multi-project settings. *International Journal of Project Management,* 24**,** 385-394.

ZWIKAEL, O. & GLOBERSON, S. 2006. From critical success factors to critical success processes. *International Journal of Production Research,* 44**,** 3433-3449.

ZWIKAEL, O., SHIMIZU, K. & GOLBERSON, S. 2005. Cultural differences in project management capabilities: a field study. *International Journal of Project Management,* 23**,** 454-462.

Appendix A: Historical Development of the Saudi Arabian Electricity Industry

Within Saudi Arabia's current borders, "Al-Madina" was the first city which experienced electricity when in 1907 the Holy Mosque of the Prophet "Mohammad" – Peace be upon Him - was connected with two 10-kilowatt electricity generators for lighting (MIE, 2000). The next place to receive electricity was the Holy Mosque of "Makkah" in 1918, before Saudi rule. After the inception of Saudi rule, the "Standard Oil of California" company was granted oil exploration and drilling rights within Saudi Arabia which, in 1932, was using electricity for drilling and lighting purposes. When the Saudi Arabian government revenues improved as a result of the commercial trading of oil, the government imported electricity generators to light the King's and princes' palaces, VIP residences, the two Holy Mosques of Makkah and Al-Madina, governmental buildings and a few other mosques. Electricity was then limited for lighting purposes only. The use of electricity then slowly developed in Saudi Arabia before it became a social necessity (MIE, 2000).

Phases of Electricity Development

Phase 1 (1951-1969)

Electricity development in Saudi Arabia can be divided into three phases (MIE, 2000). The first phase represents the period 1951-1969, a period which preceded the five-year development plans of Saudi Arabia. The Saudi government encouraged individuals and companies to form limited and modest electricity companies to meet their local demand. Therefore, loans, facilities and fuels were provided to generate electricity (MIE, 2004). The companies were located in cities and villages and, driven by supply and demand, the tariffs were different from one company to another. Technical standards also varied from one company to another (MIE, 2000). In 1961, the first Department of Electricity Affairs was established within the Ministry of Commerce to constitute adequate rules and regulations and to issue permits and licenses to electricity companies and to encourage national investment in this utility.

Phase 2 (1970 – 2000)

After introducing its first five-year development plan in 1970, the Department of Electricity Services was established in 1972 under the Ministry of Commerce. In addition to its previous roles of establishing relevant rules and regulations and issuing permits and licenses, it was then also responsible for planning electrical services for the entire Kingdom in a much more coordinated manner (MIE, 2000). In 1974, when oil revenues were becoming very promising and accounted for most of the government's earnings, the Ministry of Commerce and Industry was established and divided into two main sectors: the Commerce Agency and the Industry and Electricity Agency. The government then fixed the electricity tariff at standard prices which were at levels below their actual costs. During this period there were 103 community electricity generation companies spread over the Kingdom. The government compensated these companies by paying the difference between revenues and actual operational cost plus 15% fixed profit margin (MIE, 2004). In 1976, the government formed the General Electricity Corporation to undertake the task of executing the expansion of electricity project plans in response to the gradually increasing demand for electricity. The General Electricity Corporation played a vital role in conducting electricity infrastructure projects around the Kingdom and it represented the government's share of these projects. Since the 103 electricity companies had varying revenues and performances, some had already claimed losses that were noticeably increasing. These increased the financial burden on the government (MIE, 2000). During the period 1976 to 1981, all 103 community electricity generation companies were gradually merged into ten companies and then into the following four regional companies: Saudi Consolidated Electricity Company-West or SCECO-West, SCECO-Central, SCECO-East and SCECO-South. This was mainly to control the operational and capital investment costs and to unify the technical and operational standards around the Kingdom to address the growing demand for electricity. During this stage, the government was able to electrify many cities, villages and settlements with electricity networks extending for thousands of kilometres (MIE, 2004).

Phase 3 (2000 – present)

The Council of Ministers issued decision No. 169 of 11/08/1419H (dated November 30, 1998) stating the merger of all electric companies and the electric projects of the General Electricity Corporation into a single company called "Saudi Electricity Company" (SEC, 2003). The government evaluated this as a necessary transitional step to restructure the electricity sector in a style that could address the increasing demand for electricity (MIE, 2004). The company became operational on April 5th, 2000 and was established on a commercial basis where it provided affordable electricity.

The Council of Ministers also issued decision No. 236 (dated December 11, 2001) stating the establishment of the Electricity Co-generation Regulatory Authority (ECRA) which would report to the Minister of Water and Electricity (ECRA, 2007). Its main objectives were to regulate the electricity sector and conduct comprehensive periodic reviews of the actual cost and tariff of the service provision. It was also responsible for promoting a competitive electricity market to attract private investment in the sector and diminish the role of the Saudi Electricity Company.

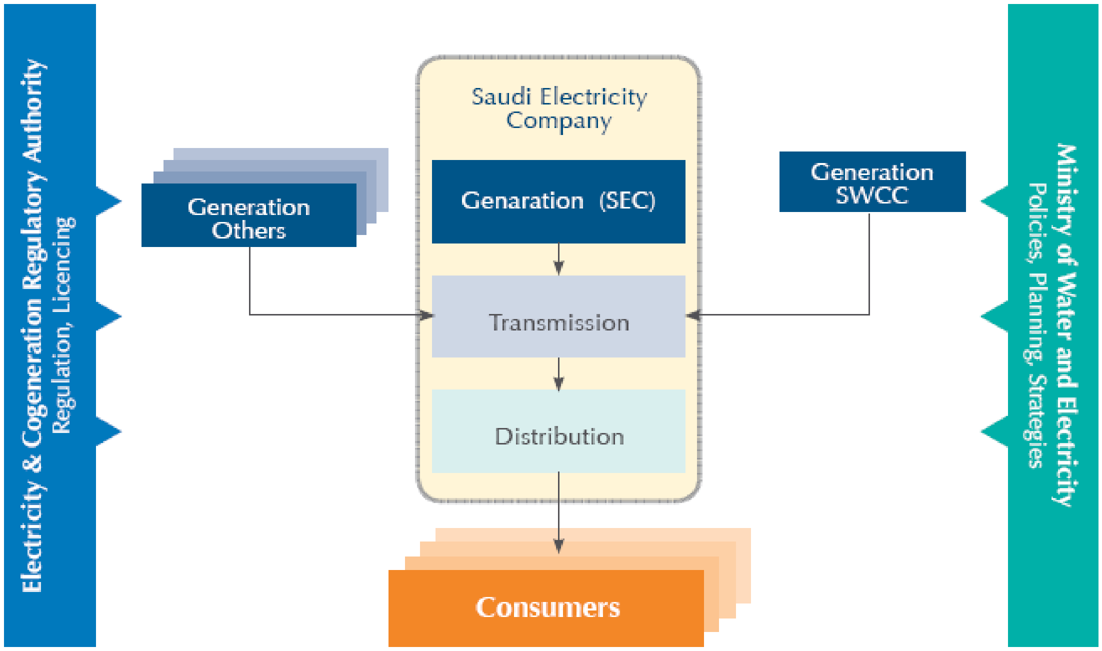
The Saudi Arabian Electricity Industry at Present

This section will outline the present structure of the Saudi Arabian electricity supply.

- **The Saudi Arabian Electricity Industry Components**

The Ministry of Water and Electricity is responsible for establishing overall policies, plans and strategies for the industry (ECRA, 2008). The Electricity Cogeneration and Regulatory Authority (ECRA) regulates the industry and issues licenses to any entity engaged in any of the activities of the electricity and water desalination industry. One of its main goals is to recommend an electricity tariff scheme that is both affordable for the consumers and attractive for the private sector to invest in the industry. The Saudi Electricity Company (SEC) is the dominant player in this industry and owns and operates most of the Saudi electricity infrastructure. A few Independent Power Producers and Independent Water and Power Producers operate alongside SEC but with much less generating capacity (ECRA, 2009a). Figure 1 below shows this structure and the interrelationships between the different stakeholders. The Saudi Arabian consumers are categorised as ‘residential’, ‘industrial’, ‘government’, ‘commercial’, and ‘others’.

Figure 1: Current organisational structure of the Saudi electricity industry (ECRA, 2007)



- **The Saudi Arabian Electricity Infrastructure**

In 2010, Saudi Arabia became the largest electricity generator in the Middle East (BMI, 2010b) (Table 1). In its 2005 World Energy Outlook, the IEA estimated that electricity consumption in Saudi Arabia was equal to 7000 kWh per capita – close to the European Union average (IEA, 2005), and it was expected to grow further.

Table 1: Selected Middle Eastern countries' power generation from 2007 - 2014

Country	2007	2008	2009	2010f	2011f	2012f	2013f	2014f
Bahrain	9.6	10	10.3	10.8	11.2	11.6	12.1	12.6
Iran	196	206.3	211.5	219.9	232	244.8	257	268
Iraq	60	70	80	90	100	115	129.4	145.5
Kuwait	49.3	52	53	55	59	62	65.7	69.7
Oman	10.9	11.5	12.1	12.7	13.3	14	14.5	15.1
Qatar	17.5	19.7	21.3	23.4	25.5	28.3	31.1	34.9
Saudi Arabia	**185.9**	**193.7**	**206.3**	**224.9**	**241.7**	**256.2**	**270**	**285**
UAE	71.9	77.2	76.5	80	85	92	98.9	105.3

f = BMI forecast. Source: BP Statistical Review of World Energy, June 2009; BMI

- **Electricity Supply Infrastructure**

The electricity supply infrastructure is conveniently divided into three areas:

1) Power Generation

The first step in the electricity production process is known as power generation. The total generation capacity in Saudi Arabia reached 51,195 MW in 2009, with an increase of 11.8% compared to the 2008 generation capacity of 45,774 MW (ECRA, 2008, ECRA, 2009a). SEC owned 87% of the total capacity (Table 2). In 2009, SEC alone increased its available generation capacity to 44.5 GW, an increase of 13.4% compared to its 2008 generation capacity of 39,200 MW (SEC, 2009).

Table 2: Generation capacities of main producers in Saudi Arabia in 2009

Production entity	Number of plants	Capacity (MW)
SEC	50	39,200*
SWCC	12	5,135
Tihama Power Generation Co.	4	1,083
Marafiq	1	1,033
Saudi Aramco	6	1,018
Saudi Cement Co.	2	266
Jubail Electricity & Water Co.	1	733
Al-Shuaiba Power Co.	1	1,191
Jubail Power Co.	1	250
Rabigh IWPP	1	120
Total	79	51,195

Source: (ECRA, 2009a)
*Source: (SEC, 2009)

2) Transmission Grids

The movement of the generated electrical power over long distances is known as power transmission (Shively and Ferrare, 2008). In 2009, the generated electrical power was transmitted through high voltage overhead lines with a total length of 25,146 km and through underground lines with a total length of 2,589 km. Figure 2 shows that in 2008 SEC's Eastern and Central operating areas were strongly interconnected with high voltage transmission lines. More than 26% of the peak load in the Central area was being served by generation in the Eastern area. This reflected a significant investment saving in electric power generation projects in the Central operating area. The interconnections between the remaining areas through high voltage transmission lines are progressing between Southern and Western operating areas and the Western with the Central operating areas. Successful completion of these interconnections will result in a single national grid that will facilitate electricity transmission all over the country (ECRA, 2007, ECRA, 2008). There is an ongoing project to integrate the six Gulf Corporation Council countries of Saudi Arabia (SEC Eastern region), Kuwait, Qatar, Oman, Bahrain and the UAE, which is due to be fully operational in 2011 (BMI, 2010b). The project is divided into three phases: the GCC North Grid, which links Saudi Arabia (Eastern region), Qatar, Bahrain and Kuwait with overhead lines and submarine cables (completed in 2009); the GCC South Grid, which links Oman and the UAE; the GCC North and South Grids which connect the first two phases (nearly completed) (Al-Asaad and Ebrahim, 2009, Al-Mohaisen, 2009). SEC has also signed a memorandum of understanding with the Egyptian Electricity Company to commission a feasibility study of a proposed transmission line which will connect between the two countries (using submarine cables through the Red Sea) (BMI, 2010c).

Figure 2: Saudi Electricity Company Working Operating Areas (SEC, 2008)

3) Power Distribution Networks

The movement of transmitted electrical power from the interconnection with the transmission system through the end-user's consumption meter is known as power distribution (Shively and Ferrare, 2008). The SEC delivered 193,472,000 MWh of electrical energy in 2009, which was an increase of 6.8% compared to 2008. The distribution network consisted of 171,888 km of overhead lines and 162,260 km of underground lines serving over 5.4 million customers, as shown in Table 3 (ECRA, 2009a, SEC, 2009).

Table 3: Distribution of consumption by consumer category in 2009

Type	Number of Subcribers	Consumption (MWh)	% of total consumption
Residential	4,675,554	100,832,000	52%
Government	195,876	26,232,000	14%
Commercial	753,325	23,203,000	12%
Industrial	7,289	34,654,000	18%
Other	69,472	8,551,000	4%
Total	5,420,810	193,472,000	100%

Source: (ECRA, 2009a)

Appendix B: The Political Economy of the Saudi Arabian Electricity Sector – Foundation of Project Implementation Challenges

Introduction

This research study is concerned with maximising the execution efficiency of authorised projects by the SEC (i.e. projects with relevant funds being allocated where these are approved to bid). It is believed that these authorised projects play a key, though partial, role in increasing the supply capacity of electricity to cope with the growing demand for the service. The main driver of this study, however, is to suggest ways to slow the acceleration of the electricity supply-demand gap, including executing expansion projects as efficiently as possible. Therefore, it is necessary to lay a foundation where a holistic view of various challenges affecting the whole industry is drawn. This study argues that this foundation will, to some extent, explain how project management as a discipline is practiced in the investigated industry today. Comprehending this foundation will be used as a departure point in which the searched Project Implementation Challenges (PICs) found a fertile ground to grow. The path needing to be taken to clarify the relevance between this foundation and the PICs, however, is highly challenging given the breadth and depth of the surrounding aspects explaining the argument.

The PDF studies previously conducted in various construction industries around the world have demonstrated that one of the most influential factors which has impeded both project authorisation and project construction has been the shortage of financial resources. The electricity industry is characterised as being highly capital intensive with high operational costs (Breeze, 2005, Khatib, 2003, Mazer, 2007, Victor and

Heller, 2008). These characteristics will even intensify financially relevant PDFs in this industry and will shape, therefore, project management practice and the relationship between key project stakeholders in the industry. This presents a mutual starting point between the holistic industry challenges as a foundation – the focus of this chapter - and the investigated PICs.

Given the political visibility of the industry where any interruption of the service can cause a wide range of inconveniences to various users, there is a great need to understand the relevant forces and variables which are causing Saudi Arabia to struggle to keep its lights on. The Saudi Arabian government has realised the urgency of the need to enhance the economic efficiency of the industry and this will be presented below. Since achieving this goal takes more than realisation, this chapter will present what actions have been taken and whether the Kingdom has successfully achieved this goal. The surrounding attributes and elements that are advancing or impeding the achievement of this goal are discussed below.

Electricity Sector Reform – Trend or Necessity?

Victor and Heller (2008) have questioned the motivation for electricity industry reforms in different parts of the world. A reform in the electricity industry entails a dramatic and necessary shift of the government's role from the actual financing and operating of the sector into an observer and regulator. The financing and operating functions will be transferred to the private sector to maximise the economic efficiency of the sector. Victor and Heller (2008) articulate several hypotheses as to why governments have sought to reform their electricity sectors. One of these hypotheses is that reforms have been viewed as a trend where governments have wanted to maximise the operational efficiency of their infrastructures (telecommunications, airports, motorways etc.) by shifting these into market-oriented organisations. This trend has specifically followed the success of the England and Wales electricity industry reforms and, thus, policy makers have thought to apply this model to their societies as a better option than state control and operation. The other end of Victor and Heller's spectrum of framed hypotheses is that the view of reform in the electricity industry has emerged from a crisis where free-markets were recognised as the only option to save the industry. Therefore, it is sensible to examine why the Saudi Arabian electricity industry is undergoing a type of reform, if in fact it is, and the potential forces advancing or impeding the reform process.

Electricity Sector Development – Historical Critical Review

It is necessary to critically review the relevant events mentioned in Chapter 2 because this will serve as the basis for what motivated the Saudi Arabian government to introduce necessary reforms in the electricity industry. The earliest model of the electric power industry in Saudi Arabia was known as 'regulated franchises'. Following this model, there were 103 community electricity generation companies spread over the Kingdom that earned commercial and profitable returns on their investments and were subject to the oversight of the government (MIE, 2004). The government then intervened several times (see Chapter 2 for more details) to control the retail prices of the service by providing each of these companies guaranteed returns. The government's interventions, however, suffered from many deep flaws. To name one, controlling retail prices by offering guaranteed profits obviously invited inefficient companies to not improve their operation management since the profits were guaranteed without any regard to performance (Farsi, 2009). Reducing tariffs significantly increased the demand for electricity and, therefore, there was greater need to increase the supplies by authorising expansion projects. As a result, the government provided these companies with large loans to expand the infrastructure and, therefore, the private investors' equities diminished as these loans represented the government's shares.

The fluctuation in government income due to the volatile oil prices, coupled with the fact that many of the 103 electricity providers claimed losses, increased the financial burdens on the government. As a result, the government merged the 103 community companies into 10 companies which gradually became 4 principal regional companies in the period 1976 to 1981 (MIE, 2000). In the late 1980s and early 1990s, oil revenues dropped significantly and this consequently severely affected the government's budget. The second Gulf War, which occurred between August 1990 and February 1991, was an unexpected event and ultimately very costly. These collectively contributed to the government's failure to maintain the provision of the 15% fixed profit margin to the private shareholders; this was then further decreased to 10%, followed by another reduction to 7% until the financially demanding industry deteriorated to its current situation. At present, there is uncertainty over the securing of more than a third of the required financial resources to authorise necessary supply projects in the period 2009-2018 (SEC, 2009).

Reforming the Electricity Sector: Restructuring Plans

The electricity industry in Saudi Arabia has proven to be a very demanding one since various resources must be deployed in a timely manner to secure a reliable provision of the service. Meeting the industry's demands, however, is crucial for maintaining the economic growth of the Kingdom's private sector and sustaining its social wellbeing. In 1995, The Ministry of Industry and Electricity suggested, with the Council of

Ministers' approval, the necessity for a restructuring of the entire industry to save it from the worsening crisis. Because there is no widely accepted typology of reform strategies, it is to be expected that Saudi Arabia, like any other country, has followed its idiosyncratic patterns in the reform process (Victor and Heller, 2008). Electricity Cogeneration Regulatory Authority has articulated a long-term goal that aims to introduce a free-electricity market model (ECRA, 2008, ECRA, 2009a) that is similar to the England and Wales electricity market model at present. Although this model indicated that further restructuring of the industry is required where the private sector will play a greater role, it is clear that the main motivation for the government to approve the free-market model was to reduce the financial burdens on its spending. In other words, approval of the reform plans emerged at a time when the electricity sector was experiencing both a financial and a technical crisis, as will be detailed below.

Figure 1 in Appendix A depicts the current (2010) organisational structure of the Saudi Arabian electricity industry. It shows that the SEC remains the dominant player in the industry since it owns and operates all transmission grids, distribution networks and 87% of the total generation capacity. Introducing private generators known as Independent Power Producers (IPPs) and Independent Water and Power Producers (IWPPs) that sell electricity to the grid (i.e. purchased by the SEC) is considered as a part of the reform process (Victor and Heller, 2008). The government has hosted private investors and offered attractive terms to build a few power generation plants. By doing this, the aim has been to reduce the intensive capital budgets allocated by the SEC – mainly with the government's support - to construct these plants.

ECRA has proposed a three-phase plan to fully implement its long-term free-electricity market model (SAMA, 2010, ECRA, 2008, ECRA, 2009a). The first phase entails unbundling the three main activities of generation, transmission and distribution into subsidiaries owned by the SEC as a holding Company. This will result in establishing competing entities in generation, an independent entity for transmission, and several entities for distribution (ECRA, 2008, ECRA, 2009a). Implementation of the unbundling process will start by early 2011 (SAMA, 2010). This phase also focuses on institutional development such as establishing a wheeling tariff and installing digital meters for heavy use consumers. A wheeling tariff sets the “amount charged by one electrical system to transmit the energy of, and for, another system or systems” (SAMA, 2010). Installing digital meters for large consumers will increase the billing efficiency. Figure 1 (next page) depicts the structure of the electricity industry after completion of Phase 1 of the restructuring plan.

Figure 1: Structure of the electricity industry after completion of Phase 1 (ECRA, 2008)

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Phase 2 focuses on implementing further institutional development laying the foundations for a competitive electricity market. Competition in this phase is limited on large consumers market to examine how successful the applied framework is (SAMA, 2010, ECRA, 2008, ECRA, 2009a). The successful implementation of Phase 2 will lead to the creation of an electricity wholesale market (Phase 3) where prices are determined through the free market forces of supply and demand, as shown in Figure 2.

Figure 0.1: Electricity industry structure after full implementation of the plan (ECRA, 2008)

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Barriers to Consistent and Stable Reform

It is accepted that the Council of Ministers sought to save the Kingdom's electricity sector from a deepening crisis. This section will point to key attributes that are observed as being serious barriers or, at least, potential threats to the successful implementation of the reform plans mentioned earlier. In order to overcome these complex and overlapping barriers, as will be examined below, an innovative set of solutions is required.

- **Slow Decision-Making**

Reviewing the historical background of the Saudi Arabian electricity sector presents two apparent observations relevant to the government's decisions towards the industry. The first is that the negative consequences of the enforced decisions were underestimated and, therefore, the challenges surrounding the industry grew until the relevant problems became acute. The enforced decisions relevant to reducing electricity tariffs, for example, promoted highly inefficient electricity usage and severe wastage of the country's natural resources, as will be discussed below. This is in addition to the noticeable increase in per capita consumption, which has almost doubled in two decades (see Table 1). The second striking observation is that when it came to acting upon these growing problems, decisions were not taken in a timely manner. For example, the Ministry of Industry and Electricity recommended that the Council of Ministers should approve restructuring of the electricity sector in 1995. The Council of Ministers approved the establishment of the SEC in 1998, as the first step for further restructuring, while the actual operation of the SEC began in 2000. Although applying any restructuring plans to such a sensitive and large industry needs time to be enforced, many other problems will occur over such a long time period. This is especially true if approving the restructuring plans was believed to save the industry without considering, for example, legislation that promotes more efficient consumption behaviour. Another example is relevant to the Gulf Council Countries transmission grid project described in Chapter 2. Although the three-phase project is due for delivery and operation in 2011, the discussion between the Council members, where Saudi Arabia is considered the most influential member, took over 20 years before the establishment of the GCC Interconnection Authority in April 2002.

Table 1: Per capita electricity consumption in Saudi Arabia (1990 – 2009)

Year	1990	1995	2000	2005	2006	2007	2008	2009
kWh/Capita	3957	4859	5542	6630	6890	7003	7300	7641

Source: (ECRA's National Electricity Registry)

- **Independence of ECRA**

As was mentioned earlier, ECRA was established in 2001 and among its main roles are to report to higher authorities on cost- reflective, fair and affordable electricity tariffs and to encourage the private sector to invest in the industry and protect their interests in order to realise fair economic returns on their investments (ECRA, 2008). This entails applying the restructuring plans to transform the industry from a vertically integrated state-owned industry into a free-market industry. However, there are a few observations that can be seen as barriers to consistent reform in the industry. Reviewing both ECRA's annual achievement reports in 2008 and 2009, it is clearly stated that the three phase plan would take eight years to achieve (ECRA, 2008, ECRA, 2009a). Although there are movements to unbundle the three main activities of the supply industry (SAMA, 2010), in addition to the development of codes for use of both transmission (completed) and distribution (in progress) networks, there is no explicit indication as to when the reform process will start or be started. The absence of such vital information (starting year and completion year) is an implicit indication that transforming the industry from a vertically integrated, state-owned one to a free-market one is highly dependent on the political will. This is especially true since ECRA lacks the key authority to modify electricity tariffs, even though it is described as an independent authority. Promoting attractive tariffs for private investors is essential for proceeding with the restructuring plans; otherwise, the investors will avoid the investment. This changed in October 2009 when the Council of Ministers authorised ECRA to modify the tariff for non-residential usage providing it does not exceed 0.26 Riyals/kWh. As was expected, both commercial and industrial users showed resistance. This is evident in the fact that ECRA did not publish the new tariff scheme until the middle of May 2010, and it began to be enforced in June 2010 (ECRA, 2010a). Knowing that the new tariff for industrial users was based on a time-of-use scheme for the period June-September presented a flaw in the ECRA scheme in that such short notice prevented many consumers from re-scheduling their operational plans. However, this might also present evidence of the extreme resistance and the last-minute lobbying of both commercial and industrial users to reduce the newly proposed tariff as much as possible.

- **Investment Return of an Electricity Supply Project – Economic Evaluation**

The electricity supply industry has various direct benefits for a society. Therefore, a project economic assessment must consider its impact on social wellness in addition to the industrial and commercial businesses. However, a holistic project economic assessment will partially explain the Saudi government’s reluctance to fully finance projects required to increase the supply capacities. The electricity demand trend in Saudi Arabia has raised concerns about the economic feasibility of these highly capital intensive projects. In the summer of 2010, the load peaked when it reached 43,933 MW (ECRA, 2010b) while, during other seasons, it dramatically dropped to as low as 25,000 MW. The extreme weather in the summer of 2010, where in some parts of the Kingdom the temperature exceeded 50 degrees Celsius, spiked the electricity demand and exceeded the SEC's forecasts as the demand grew just over 10% when compared to the peak load in 2009. The main operational cost implication is that several power plants, which have cost thousands of millions of Riyals, operate for a few days only. In the summer of 2007, there were generating units with total capacities of 2,000 MW that operated for 12 days only. Moreover, there were generating units with total capacities of 5,000 MW that operated for only 4.5 months in the same summer (ECRA, 2009b). This obviously significantly decreased the cost-benefit ratio of these non-operating projects where the demand fluctuated around 40% during the year. This demand trend caused serious concerns for the Independent Power Producers as there would be an apparent surplus in electricity production from their facilities in non-summer seasons. This is especially true knowing that electricity produced by IPPs is sold to the SEC on a commercial basis and, therefore, is more expensive than electricity produced by the SEC's own facilities. Therefore, private investors made it clear that in order to build and operate power plants, the SEC, as the grid owner, had to sign a 20-year Power Purchase Agreement at the minimum, otherwise the investments were considered too risky for these investors and they would have to withdraw from the industry. The SEC was forced to agree and, therefore, had to shut down many facilities in which it placed significant investments during non-summer seasons.

Another important aspect questions the return on investment in electricity supply projects in Saudi Arabia. Although the consumption rate in Saudi Arabia has been maintaining a steady growth where sales are projected to increase, most of the consumption, however, has been accounted for by residential users (53.4%) while less than a third (29.5%) has been accounted for by both commercial and industrial users combined (ECRA, 2009a). This has raised the question of not only to what extent power industry projects are economic, but, most importantly, what role the power industry has played in the Saudi Arabian non-oil economy.

- **Perverse Subsidies**

In a relevant matter that questions the electricity industry's role in sustaining Saudi Arabia's economic growth, the problem of subsidies has recently become particularly acute. A subsidy is broadly defined as follows:

> Subsidies comprise all measures that keep prices for consumers below market level or keep prices for producers above market level or that reduce cost for consumers and producers by giving direct or indirect support.
>
> (Moor, 2001)

Governments provide many forms of energy subsidies to stimulate economic growth and to enhance the security of energy supply along with keeping the prices affordable to consumers (Badcock and Lenzen, 2010, Ritschel and Smestad, 2003, Moor, 2001). Energy subsidies, however, can have an overall adverse effect on the society and the economy and these are described as 'perverse' subsidies (Ritschel and Smestad, 2003). This section will focus on two particular forms of perverse subsidies that are of serious concern for national security. In fact, one of these subsidies, which is the capping of fuel prices used for electricity generating plants and transportation in Saudi Arabia, brought into question the future demand-supply stability of the international oil market (Schindler, 2010). One major reason for this is because over half the fuel used to generate electricity in Saudi Arabia was oil (Table 6.2), and this is projected to increase significantly.

Table 2: Fuel types used for electricity generation in 2008 and 2009

Fuel Type	2008 usage	2009 usage
Natural gas	45%	38%
Diesel	22%	22%
Crude oil	20%	34%
Heavy fuel oil	13%	6%

Source: (ECRA, 2008, ECRAa, 2009)

It has already been explained that for many decades Saudi Arabia has played a key role in supplying oil to the international energy market. The Saudi government is keen to maintain this role for many more decades knowing that it has ownership of 19.8% of the world's proven oil reserves (BP, 2010). Oil revenues have accounted for 90% of the Kingdom's total export earnings, around 75% of government budget revenues and 45% of GDP (OPEC, 2010). The major concern, however, in addition to the vulnerability of oil price fluctuations, is that the domestic demand for energy is growing steadily in a manner that will reduce oil availability for exports. This is of especial concern when considering the fact that the International Energy Agency has recently identified that Saudi Arabia offers the third highest level of energy subsidies in the world, which is equivalent to over 10% of its GDP (IEA, 2010). The government has offered the SEC highly subsidised fuel prices that are far below international market prices. The Council of Ministers issued a Royal Decree in 2006 to have Saudi

Aramco, the national oil company, set the fuel price for the oil supplied to the SEC. The government capped the price for Heavy Fuel Oil supplied to the SEC by Saudi Aramco at US $2 – 2.64 per barrel subject to its grade (SEC, 2009). This also entailed that private investors and developers involved in the Independent Power Producer or Independent Power and Water Producer business structures would receive the fuel from SEC at no cost (which, as will be elaborated on next, is already struggling to pay for the fuel). Knowing that Brent oil averaged a price of US $61.67 per barrel in 2009 (BP, 2010) gives a good indication of how much revenue the government would have generated from the oil being sold to the international market. Table 6.3 presents the Saudi Arabian oil production and consumption levels for the period 2002 to 2009. Clearly, production levels fluctuated in the quoted period, driven by the global oil demand while domestic oil consumption was growing steadily. With regard to the issue of the increasing domestic consumption for energy, Saudi Aramco's CEO, Mr. Khalid Al-Faleh, announced that

> If no energy efficiency improvements are achieved, and the business is as usual, the oil availability for exports is likely to decline to less than 7 million barrels per day by 2028, a fall of 3 million barrels a day while global demand for our oil is likely to continue to rise.
>
> (Allam and England, 2010)

Table 3: Saudi oil production and consumption (million barrels/day)

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Source: (BP, 2010)

For the above reasons, in addition to being more efficient and environmentally friendlier when compared to oil-fired generation, gas-fired generation was considered more favorable as a means for producing power (SEC, 2003). However, the reduction in gas production between 2008 and 2009 (Table 4) was due to supply constraints. This has apparently complicated the problem, limiting the option of bridging the fuel supply shortage with crude oil (Table 2) (Schindler, 2010).

Table 4: Saudi production and consumption (million tonnes of oil equivalent)

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Source: (BP, 2010)

The above has shown that the Saudi Arabian energy policy has clearly promoted intensive and increasing usage of its natural fossil energy resources to meet its increasing domestic demand for energy (including electricity and transportation). This has had environmental implications as well. A dramatic political change, however, was realised when King Abdullah announced in Riyadh announced the establishment of the King Abdullah City for Nuclear and Renewable Energy (Allam, 2010a). This was observed as an indication that the government has considered adopting a mix-generation policy. Although the new establishment is already negotiating with international companies to build the city (Carey, 2010), it may take a few years to realise the first nuclear power plant or a plant with renewable fuel (solar, wind, tidal etc.). It is very important to focus on these clean technologies since Saudi Arabia was recently identified as being among the world's top ten emitters of carbon dioxide (Doyle and Dobbie, 2010).

The second form of perverse energy subsidy is concerned with the capping of electricity retail prices in Saudi Arabia. This subsidy was meant to promote affordable electricity prices for consumers but came with unwanted financial and technical implications for the vertically integrated service provider, the SEC. This topic has been extensively referred to in this research. But, it is worth mentioning that the recent modification of tariffs for non-residential usage has faced serious resistance from both commercial and industrial users. As was mentioned earlier, ECRA has been authorised since October 2009 to enforce a new tariff scheme, but commercial and industrial consumers have created political lobbies to support the maintaining of the subsidies (Ritschel and Smestad, 2003) despite the negative impact the subsidies are having on the industry's overall ability to provide a reliable service. This explains why ECRA published the new tariff scheme in the middle of May 2010. The financial and technical implications of the low tariffs are discussed below.

- **Adverse Financial Implications for the SEC**

As was mentioned previously, the SEC has inherited large debts from the merged companies. This is because these companies were squeezed between inadequate revenues and rising costs while the government was increasingly unable to cover the difference. In addition to these debts, the SEC lost 40,000 million Riyals for the period 2000 – 2009 (4,000 million Riyals per year) as a direct result of the government's intervention in reducing the tariff within the Company's first seven months of operation (SEC, 2009).

Knowing that the electricity infrastructure is financially demanding with intensive operational costs and capital projects, the SEC was unable to pay the government for the supplied fuel since it began operating in 2000 (SEC, 2007). As a result, the governmental institutions refrained from paying for the service until the end of 2005. Consequently, the SEC's financial situation significantly deteriorated, affecting its technical performance until the government finally agreed to settle the payments for government electricity usage for the period 5th April 2000 to 31st December 2005. Payments were agreed to be made over a period of three years effective from 2007 (SEC, 2007), while the SEC will repay the government for the fuel supply over the next 25 years.

Authorising ECRA to increase the tariff in October 2009 was observed as one positive indication of the government's seriousness to reform the industry. The question remains as to what implications this tariff change has for the industry. The new tariff scheme is thought to provide essential financial resources required to operate and expand the existing infrastructure. The average cost of unit electricity (kWh) in the Kingdom is 0.142 Riyals per kWh while the average price collected from consumers by the SEC was 0.125 Riyals per kWh before applying the new tariff in 2010. After applying the new tariff, the average price collected from the consumers by the SEC increased to 0.137 Riyals per kWh (ECRA, 2010a). The governmental consumers will provide the greatest contribution to this increase (38% of total income increase or 1,200 million Riyals) as each governmental user will now pay a flat rate of 0.26 Riyals/kWh for the whole year. The commercial users will account for 30% of the income increase (940 million Riyals). Over 70% of the commercial users have an average consumption bill of less than 100 Riyals per month (Table 6.5) (ECRA, 2010a).

Table 5: Electricity tariff for commercial users as of 15th May, 2010

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The industrial users will account for 32% (1,040 million Riyals) of the SEC's income increase as a result of the application of the new tariff. It is worth noting that large industrial users pay a flat rate of 0.14 Riyals per kWh and small industrial users pay a flat rate of 0.12 Riyals per kWh in non-summer seasons (October – May). During the period June – September when the load peaks, all industrial consumers with non-digital meters pay a flat rate of 0.15 Riyals per kWh. Consumers with digital meters pay as high as 0.26 Riyals per kWh during the peak load hours in summer (12:00 – 17:00 pm from Saturday to Thursday) but pay as little as 0.10 Riyal per kWh during off-peak hours. This is to encourage consumers to install digital meters in their premises and most importantly to dispatch their loads from peak to off-peak hours. The main observation to be gained from this is that the total income increase from the new tariff scheme is 3,180 million Riyals. This implies that the income increase does not fully cover SEC's shortage. It is also interesting to report that ECRA has reported the shortage of financial resources required for the industry amounts to 3,800 million Riyals per year (ECRA, 2010a) while the SEC reported a shortage of 4,000 million

Riyals per year (SEC, 2009). However, the ECRA has launched a project to study and monitor the capital and operation costs and expenditures of the SEC (SAMA, 2010).

The researcher has also observed a particular problem that is relevant to the worsening of the SEC's financial status. This is the ability to collect consumption payments from what the SEC has described in the English version of its annual report as 'Special Customers' (SEC, 2009). Some of these 'Special Customers', or VIP consumers as they are referred to in the Arabic version, were not paying promptly for their consumption. The researcher had an informal chat with an SEC officer (managerial level) working for the Distribution Customer Relations Department and explicitly asked him how this persistent problem is affecting the SEC's finances. The answer was, understandably, a divergence from the question. There is no clear definition in the SEC's reports as to what constitutes a customer as 'special', but most probably these are customers with power since the SEC can never send an officer to disconnect the services from those who did not pay for the service.

The SEC indicated that the receivable payments from 'Special Customers' that are yet to be made amounted to 1,878 million Riyals in 2008. The amount increased to 1,958 million Riyals in 2009 (SEC, 2009). As with 'doubtful receivables', these also increased from 116.6 million Riyals in 2008 to 126 million Riyals in 2009. This is valued as a barrier to businesses considering investment in the Distribution area since there is a serious lack of legislation and regulations that protect investors' interests.

- **Adverse Technical Implications**

The financial difficulties described above have had a direct impact on the electric power system's technical capabilities. The SEC has been forced to delay replacing aged infrastructure systems (SEC, 2009). This has consequently increased the operational and maintenance costs of these systems. For example, although the SEC has estimated the operational lives of its generating plants to range between 20-25 years, Table 6.6 shows some generating units that exceeded 35 years in operation (ECRA, 2010c). This will raise serious concerns, assuming reforming the industry is progressing as planned, as to which entities will hold liabilities when these units fail and result in service interruption for consumers. This is especially true knowing that over half of the total of 622 generating units existing in the Kingdom in 2008 were operating beyond their lifetime expectancy (ECRA, 2009b).

Table 6: Generating units with age of 35 years and over

Concluding Remarks

The above has shown that the Saudi Arabian government has realised the necessity of enhancing the economic efficiency of the demanding electricity industry by applying the radical transformation of moving from a state-owned vertically integrated industry into a free-market industry. However, in seeking to consistently achieve the ECRA model, such a transformation, in which major restructuring plans will need to take place, faces a variety of serious barriers. These barriers are complex and overlap with each other. Among these barriers is the government's interaction behaviour with the industry-related organisations to apply the reform strategies. Enforcing decisions such as lowering the tariffs that promoted rapid increases in demand for electricity without allocating proper financial resources to authorise projects to increase the supplies has created many challenges for the service provider. The SEC had to authorise the urgent expansion of supply projects with insufficient resources and, therefore, failed to pay the government for the fuel supply. This was especially true when the government lowered the suggested tariff scheme proposed once the SEC was established. As a result, the Council of Ministers established an independent regulator, ECRA, to suggest tariffs that would be affordable for the consumers and attractive for the private sector to invest in the industry. The problem with the introduction of the subsidised tariffs was the creation of political lobbies, especially by industrial and commercial consumers, who supported the continuation of these subsidies. Although ECRA was established in 2001, it was authorised for the first time to enforce a new tariff scheme for non-residential users in October 2009. The major observation, in addition to the slow provision of providing ECRA with the key authority of enforcing new tariffs, was

the resistance of industrial and commercial users. This forced ECRA not to settle the tariff scheme until its publication two weeks before its enforcement. Revenues from the new tariff are crucial to the operation and expansion of the industry but will not fully cover the financial resources required for such operation and expansion. These events are being closely observed by the private sector who may decide to invest in the electricity infrastructure to examine whether reforms will consistently take place.

Besides these observations, the demand trend for electricity has significantly lowered the potential returns on investments. This has tightened the IPP owners' terms in the signing of a long-term Power Purchase Agreement with the SEC, causing even further financial constraints.

Reviewing and monitoring the capital and operation costs and expenditures of the SEC by ECRA may present political challenges. There may be resistance by the SEC to present a maximum level of transparency while ECRA will need to exert leadership qualities to present itself as an independent and competent organisation. The ability to collect payments from customers needs to be addressed properly otherwise investors will not take the risk when privatising distribution facilities. Similarly, the aging electrical systems indicate these cannot be easily privatised (i.e. sold to private investors), especially since many of the generating units, for example, have exceeded their lifetime expectancy.

The government has provided the SEC with financial resources but was reluctant to provide these in a timely manner or sufficiently. The main driver for such behaviour could be reasoned by the fact that the government has provided very large subsidies for the fuel supplies to generate electricity. The domestic consumption of energy, however, is rising at a very fast rate and this will cause serious economic and environmental concerns in the next decade for both Saudi Arabia and the oil market.

Appendix C: Letter Sample sent to Research Participants – Data-Collection (Phase I)

Dear Dr. Saleh Al-Awaji,

Deputy Minister of Electrical Affairs

Our Nation is blessed with enormous natural energy resources which, with Allah's blessings, have provided the country with unique political and economic leverages. This is because energy is the wheel toward economic development. Despite the availability of these substantial resources, in addition to being as a recognised energy resource exporter, the Kingdom seems to be facing unexpected challenges in this particular area. Power project supplies seem to be unable to cope with the increasing demand for electricity, especially with the exceptional growth of the various local industries and population. This calls for a clear strategy and vision to overcome these growing challenges. Projects are among the most important tools to transfer these strategies into reality. Since my Doctorate research will tackle the challenges impeding project progress in the Saudi Electricity Supply Industry, I would be grateful if I could conduct an interview with you to explore and address your concerns. Your vast experience in this area and your being close to the decision makers in the government will certainly illuminate and serve the research objectives.

Bandar Khalid Alhoweish

Mobile: 0541256065

Attachment: Copy of the Researcher's educational Sponsor to confirm his identity and affiliation.

Copy of the letter issued by the researcher's sponsor to assist him in collecting the necessary data.

Royal Embassy of Saudi Arabia
Cultural Bureau
London

المملكة العربية السعودية
وزارة التعليم العالي
المكتب الثقافي في بريطانيا

الشئون الأكاديمية: ٦٦٥ S

إفـــــادة

يُـفيد المكتب الثقافي السعودي في بريطانيا بأن الطالب / **بندر خالد ابراهيم الهويش** بـرقم ٦٦٥ S هو أحد الطلبة المبتعثين من قبل وزارة التعليم العالي لدراسة درجة الدكتوراه فـي مجال الإدارة الصناعية بجامعة أستون في بريطانيا إلى تاريخ ٠٧/٠٦/١٤٣٠هـ ويقوم الآن برحلة علمية في المملكة لمدة ثلاثة أشهر لجمع المعلومات والاستبيانات الخاصة بدراسته.وقد مُنح هذه الإفادة بُناءً على طلبه لتقديمها إلى من يهمه الأمر، لمساعدته في جمع المعلومـات والاستبيانات المطلوبة.

والله الموفق،،،

الملحق الثقافي في بريطانيا

عبدالله بن محمد الناصـــر

NO. ٤/٤٩٢٢ DATE: ٦/٦/١٤٣٠ ENC.
29 BELGRAVE SQUARE, LONDON SW1X 8QB TEL: 020 7245 9944 FAX: 020 7245 9895 E-MAIL: sacbuk@sacb.co.uk

Appendix D: Approval Letter Issued by the SEC Granting the Researcher with Data Accessibility

Western Operating Area
Internal Correspondence

منطقة أعمال الغربية
مراسلات داخلية

الشركة السعودية للكهرباء
Saudi Electricity Company
طاقة مثمرة

الرقم :
التاريخ :
المرفقات :

المكرم المبتعث/ **بندر بن خالد الهويش** وفقه الله

السلام عليكم ورحمة الله وبركاته،،،

بالإشارة إلى خطابكم بتاريخ ١٤٢٨/٣/٢٣هـ الموافق ٢٠٠٧/٠٤/١١م والموجه إلى سعادة الرئيس التنفيذي بالشركة السعودية للكهرباء بخصوص طلبكم جمع معلومات واستبيانات تتعلق بعوامل نجاح مشاريع الكهرباء وكذلك فهم العوامل المؤدية لتأخير تلك المشاريع.

عليه نفيدكم بموافقة الشركة على مساعدتكم في توفير ما يمكن من معلومات عن قطاع الكهرباء .

مع تمنياتنا لكم بالتوفيق والنجاح ،،،

نائب رئيس أول منطقة أعمال الغربية

فؤاد بن جويد الشريبي

Appendix E: Confidentiality Statement with Research Objectives

Identifying Project Delay Factors in the Electricity Supply Projects

Dear respected SEC employee,

As the national economy is growing rapidly, there is an urgent need to expand the existing infrastructure. Therefore, executing projects related to generating, transmitting and distributing electrical energy must be in line with national needs. This questionnaire is meant to address delay factors facing power projects identified by a wide range of project managers. Collecting data through interviews is part of my Doctorate programme in Industrial Management and Design at Aston University in the United Kingdom. I kindly ask you to take part in the interview. Attached is the approval of the SEC CEO and President to conduct this research on your premises. I hereby confirm the confidentiality of the participants' identity according to scientific research ethical codes.

Researcher: Bandar Khalid Alhoweish

e-mail: alhoweib@aston.ac.uk

Mobile: 0541256065

Attachments: Approval letter issued by the SEC CEO (Appendix B) and the letter issued by the sponsor identifying the researcher's identity (Appendix A).

Appendix F: Semi-structured interviews (Data-Collection Phase II) – Sample of pre-determined questions

What is your job title?

What is your role?

What are your Department's/Division's roles?

Can you give examples of reasons contributing to delaying your projects?

How do you make sure that a project is progressing as expected?

How does your organisation assess the progress of a project team or a project manager?

Do you conduct post-implementation reviews?

What kind of training is available to enable you with better performance?

Appendix G: Questionnaire Survey (Data-Collection Phase II)

Identifying Project Delay Factors in the Electricity Sector Questionnaire Survey

As the national economy is growing rapidly, there is an urgent need to expand the existing infrastructure. Therefore, executing projects related to generating, transmitting and distributing electrical energy must be in line with the national needs. This questionnaire is meant to address delay factors facing power projects identified by wide range of project managers.

Analyzing this questionnaire is part of my Doctorate programme in Industrial Management and Design Research Group in Aston University in Birmingham city in the United Kingdom. I kindly ask you to participate in the questionnaire that will not take more than 15 minutes to fill. Anyone is interested in knowing the results of the research shall enclose his/her email with the questionnaire or, alternatively, email me. I hereby confirm the confidentiality of the participant's identity according to scientific research ethical codes.

Researcher: Bandar Khalid Alhoweish

e-mail: alhoweib@aston.ac.uk

Mobile: 0541256065

- Participant’s job: (please tick the most suitable answer)

  □ Department/ division manager □ Project manager □ Project engineer

  □ Consultant engineer □ other __________

- Type of organisation I work for:

  □ Project owner □ Contractor □ Consultancy □ Subcontractor

- Participant’s project management experience (in years): ______________

- Project type I have been involved in managing: (please tick all answers that apply)

Power Generation	Power transmission	Power distribution
□ Gas turbine plants	□ Substations	□ Distribution networks
□ Steam turbine plants	□ Overhead lines	□ Diesel generation plants
□ CCGT plants	□ Underground cables	□ Rural electrification
	□ Load dispatch centers & SCADA systems	

Please draw a circle around the suitable number that expresses how frequent AND severe you experience the following delay causes:

List of Contractor performance delay causes: (materials, equipment and manpower)

Cause	Frequency scale				Severity scale			
	Always	Often	Sometimes	Never	Very Severe	Severe	Somewhat severe	No effect
a. Shortage of materials required (e.g. cement, steel, bricks, etc.)	4	3	2	1	4	3	2	1
b. Delay in materials delivery	4	3	2	1	4	3	2	1
c. Changes in materials prices	4	3	2	1	4	3	2	1
d. Changes in materials specifications	4	3	2	1	4	3	2	1
e. Shortage of equipment required (transformers, drillers, switchgears, etc)	4	3	2	1	4	3	2	1
f. Failure of equipment	4	3	2	1	4	3	2	1
g. Inadequate equipment used for the works	4	3	2	1	4	3	2	1
h. Shortage of manpower	4	3	2	1	4	3	2	1
i. Low skill of manpower	4	3	2	1	4	3	2	1

List of Contractor performance delay causes: (Project Management)

Cause	Frequency scale				Severity scale			
	Always	Often	Sometimes	Never	Very Severe	Severe	Somewhat severe	No effect
a. Shortage of contractor's administrative personnel	4	3	2	1	4	3	2	1
b. shortage of technical professionals in the contractor's organization	4	3	2	1	4	3	2	1
c. Poor communication by the contractor with the parties involved in the project	4	3	2	1	4	3	2	1
d. Contractor's poor coordination with the parties involved in the project	4	3	2	1	4	3	2	1
e. Slow preparation of change orders requests by the contractor	4	3	2	1	4	3	2	1
f. Ineffective contractor head office involvement in the project	4	3	2	1	4	3	2	1
g. Delay in mobilization	4	3	2	1	4	3	2	1
Cause	Frequency scale				Severity scale			
	Always	Often	Sometimes	Never	Very Severe	Severe	Somewhat severe	No effect
h. Loose safety rules and regulations within the	4	3	2	1	4	3	2	1

contractor's organization								
i. Poor qualification of the contractor's technical staff assigned to the project	4	3	2	1	4	3	2	1
j. Improper technical study by the contractor during the bidding stage	4	3	2	1	4	3	2	1
k. Ineffective planning and scheduling of the project by the contractor	4	3	2	1	4	3	2	1
l. There are no effective or realistic contingency plans in case the project is behind schedule or over budget	4	3	2	1	4	3	2	1
m. Delay of field survey by the contractor	4	3	2	1	4	3	2	1
n. Ineffective control of the project progress by the contractor	4	3	2	1	4	3	2	1
o. Inefficient quality control by the contractor	4	3	2	1	4	3	2	1
Cause	Frequency scale				Severity scale			
	Always	Often	Sometimes	Never	Very Severe	Severe	Somewhat severe	No effect
p. Delay in the preparation of contractor submissions	4	3	2	1	4	3	2	1

List of Contractor Performance delay causes: (Project Finance)

Cause	Frequency scale				Severity scale			
	Always	Often	Sometimes	Never	Very Severe	Severe	Somewhat severe	No effect
a. Difficulties in financing the project by the contractor	4	3	2	1	4	3	2	1
b. Cash flow problems faced by the contractor	4	3	2	1	4	3	2	1
c. Problems between the contractor and his subcontractors with regards to payments	4	3	2	1	4	3	2	1

List of Owner administration delay causes:

Cause	Frequency scale				Severity scale			
	Always	Often	Sometimes	Never	Very Severe	Severe	Somewhat severe	No effect
a. Delay to furnish and deliver the site to the	4	3	2	1	4	3	2	1

contractor by the owner								
b. Delay in the settlement of contractor claims by the owner	4	3	2	1	4	3	2	1
c. Suspension of work by the owner	4	3	2	1	4	3	2	1
d. Delay in issuance of change orders by the owner	4	3	2	1	4	3	2	1
e. Slow decision making by the owner	4	3	2	1	4	3	2	1
f. Uncooperative owner with the contractor complicating contract administration	4	3	2	1	4	3	2	1
g. Delay in progress payments by the owner	4	3	2	1	4	3	2	1
Cause	Frequency scale				Severity scale			
	Always	Often	Sometimes	Never	Very Severe	Severe	Somewhat severe	No effect
h. Owner's poor communication with related government authorities	4	3	2	1	4	3	2	1
i. Owner's poor communication with the parties involved (contractor, consultant)	4	3	2	1	4	3	2	1

during project execution								
j. Owner’s failure to coordinate with government authorities during planning	4	3	2	1	4	3	2	1
k. Poor coordination by the owner with the various parties during project execution	4	3	2	1	4	3	2	1

List of Early planning and design delay causes:

Cause	Frequency scale				Severity scale			
	Always	Often	Sometimes	Never	Very Severe	Severe	Somewhat severe	No effect
a. Changes in the scope of project	4	3	2	1	4	3	2	1
b. Ambiguities, mistakes and inconsistencies in specifications and drawings	4	3	2	1	4	3	2	1
c. Site conditions materially differing from contract documents	4	3	2	1	4	3	2	1

d. Original contract duration is too short	4	3	2	1	4	3	2	1

List of regulations delay causes:

Cause	Frequency scale				Severity scale			
	Always	Often	Sometimes	Never	Very Severe	Severe	Somewhat severe	No effect
a. Ineffective delay penalty	4	3	2	1	4	3	2	1
b. Difficulties in obtaining work permits	4	3	2	1	4	3	2	1
c. Owners tendering system requirement of selecting the lowest bidder	4	3	2	1	4	3	2	1
d. Changes in government regulations and laws	4	3	2	1	4	3	2	1

List of Site and Environment conditions delay causes:

Cause	Frequency scale				Severity scale			
	Always	Often	Sometimes	Never	Very Severe	Severe	Somewhat severe	No effect
a. Severe weather conditions on the job site	4	3	2	1	4	3	2	1
b. Effects of subsurface conditions (type of soil, other utility lines)	4	3	2	1	4	3	2	1
c. Traffic control and	4	3	2	1	4	3	2	1

restrictions on the job site (difficulties to reach the site)								
d. Effects of social and cultural conditions (Locals behavior and/or manpower different backgrounds)	4	3	2	1	4	3	2	1
e. Work interference between various contractors	4	3	2	1	4	3	2	1

List of Site Supervision delay causes:

Cause	Frequency scale				Severity scale			
	Always	Often	Sometimes	Never	Very Severe	Severe	Somewhat severe	No effect
a. Poor qualification of consultant engineer's staff assigned to the project	4	3	2	1	4	3	2	1
b. Delay in the approval of contractor submissions by the engineer	4	3	2	1	4	3	2	1
c. Poor communication between the consultant engineer and other parties involved	4	3	2	1	4	3	2	1
d. Poor coordination by the consultant engineer with other parties	4	3	2	1	4	3	2	1

involved								
e. Delay in performing inspection and testing by the consultant engineer	4	3	2	1	4	3	2	1
f. Slow response from the consultant engineer to contractor inquiries	4	3	2	1	4	3	2	1

Thank you for your appreciated cooperation

Please write any comments on this page

You may inform me to collect the questionnaire with many thanks

بسم الله الرحمن الرحيم

استبيان لمعرفة عوامل تأخر المشاريع في قطاع الكهرباء بالمملكة

باستمرارنمو الاقتصاد الوطني بوتيرة متسارعة, أصبحت الحاجة الى زيادة سعة توليد الطاقة الكهربائية ملحة و ماسة. ولذلك فان من الضروري أن يكون أداء تنفيذ المشاريع الخاصة بتوليد ونقل وتوزيع الكهرباء مواز للحاجة الوطنية. وحيث أن الشركة السعودية للكهرباء هي المسؤولة عن تخطيط و تمويل مشاريع قطاع الكهرباء بالمملكة, فان موضوع الاستبيان يشمل التعرف على أسباب تأخر سير المشاريع في حدود الميزانية المعهودة ووفق الزمن المخصص وبجودة مقبولة.

ومن خلال هذا الاستبيان أسعى للحصول على درجة الدكتوراة في تخصص ادارة صناعية و تصميم من جامعة أستن الواقعة بمدينة برمنغهام بالمملكة المتحدة. أرجو منكم التكرم بالمشاركة في هذا الاستبيان علما بأن المدة المطلوبة لإكمال الاستبيان لا يتجاوز خمس عشر دقيقة. وأرجو لكل من يرغب بالاطلاع على نتائج البحث ارفاق البريد الالكتروني مع الاستبيان أو مراسلتي على بريدي الالكتروني. و أود أن أؤكد لكم بأن هوية المشاركين والمعلومات المقدمة من خلال الاستبيان سوف تعامل بخصوصية و سرية تامة حسب الاجراءات المتبعة في أخلاقيات البحث العلمي.

وظيفة المشارك :

□ مدير ادارة المشاريع　□ مدير دائرة مشاريع　□ مدير مشروع　□ مهندس مشروع　□ مهندس استشاري

□ وظيفة أخرى (______________________________________)

تصنيف الشركة أو المؤسسة التي أعمل لديها:

□ مالك مشروع □ مقاول □ استشاري □ مقاول بالباطن

خبرة المشارك في ادارة المشاريع (عدد السنين):__________

المشاريع التي أشارك في تنفيذها تنتمي لقطاع: (الرجاء اختيار كل الاجابات المناسبة)

□ التوليد □ النقل □التوزيع

□ خطوط أرضية □ خطوط هوائية □ محطات تحويل

□مجطات توليد غازية □ محطات توليد بخارية □ كهربة قرى

□ أخرى ______________________

القوائم التالية تحتوي على أسباب مختلفة تساهم في تأخرسير المشاريع:

أرجو رسم دائرة حول الاجابة التي ترونها مناسبة حسب خبرتكم, علما بأن كل فقرة بحاجة الى اجابتين, اجابة تشير الى مدى تكرار السبب واجابة تشير الى مدى أثر ذلك السبب على سير المشاريع.

قائمة(أداء والتزام المقاول – مواد /معدات / عمالة):

السبب	مدى التكرار				مقياس الأثر			
	أبدا	أحيانا	عادة	دائما	غير مؤثر	مؤثر الى حد ما	مؤثر	مؤثر جدا
أ. نقص المواد المطلوبة	١	٢	٣	٤	١	٢	٣	٤
ب. تأخر تسليم المواد	١	٢	٣	٤	١	٢	٣	٤
ج. تغير في أسعار المواد	١	٢	٣	٤	١	٢	٣	٤
د. تغير في مواصفات المواد	١	٢	٣	٤	١	٢	٣	٤
ه. نقص في المعدات المطلوبة	١	٢	٣	٤	١	٢	٣	٤
و. حدوث عطال في المعدات	١	٢	٣	٤	١	٢	٣	٤
ز. المعدات الموجودة الغير مؤهلة للأعمال	١	٢	٣	٤	١	٢	٣	٤
ح. نقص في العمالة (سواء كانو مؤهلين أو غير مؤهلين)	١	٢	٣	٤	١	٢	٣	٤
ط. وجود عمالة غير مؤهلة	١	٢	٣	٤	١	٢	٣	٤

قائمة (أداء والتزام المقاول – ادارة مشاريع):

السبب	مدى التكرار				مقياس الأثر			
	أبدا	أحيانا	عادة	دائما	غير مؤثر	مؤثر الى حد ما	مؤثر	مؤثر جدا
أ. نقص الاداريين لدى المقاول	١	٢	٣	٤	١	٢	٣	٤
ب.نقص الفنيين المحترفين لدى	١	٢	٣	٤	١	٢	٣	٤

المقاول								
ج.افتقار المقاول لسبل الاتصال وتبادل المعلومات اللازمة مع الجهات ذات الصلة للمشروع	١	٢	٣	٤	١	٢	٣	٤
د. افتقار المقاول القدرة على التنسيق مع الجهات ذات الصلة للمشروع	١	٢	٣	٤	١	٢	٣	٤
ه.بطء الاعداد لطلبات ال (Change of orders) من قبل المقاول	١	٢	٣	٤	١	٢	٣	٤
و. عدم تفاعل مكتب ادارة المقاول بالشكل المناسب	١	٢	٣	٤	١	٢	٣	٤
ز. تأخر نشر المقاول لمعداته وعمالته في الموقع	١	٢	٣	٤	١	٢	٣	٤
ح. لين قوانين السلامة لدى المقاول	١	٢	٣	٤	١	٢	٣	٤
ط. افتقار عمالة المقاولين الفنيين المعينين في المشروع للمؤهلات	١	٢	٣	٤	١	٢	٣	٤
ي. دراسةفنية غير مناسبة أثناءاعداد العروض من قبل المقاول	١	٢	٣	٤	١	٢	٣	٤
ك. عدم فاعلية خطة وجدولة المشروع من قبل المقاول	١	٢	٣	٤	١	٢	٣	٤
ل. تأجيل مسح الموقع من قبل المقاول	١	٢	٣	٤	١	٢	٣	٤
م. متابعة غير فعالة لسير المشروع من قبل المقاول	١	٢	٣	٤	١	٢	٣	٤
ن. مراقبة جودة غير فعالة من قبل المقاول	١	٢	٣	٤	١	٢	٣	٤

ص. تأخر اعداد ما يجب تسليمه من قبل المقاول	١	٢	٣	٤	١	٢	٣	٤

قائمة (أداء والتزام المقاول المالية)

السبب	مدى التكرار				مقياس الأثر			
	أبدا	أحيانا	عادة	دائما	غير مؤثر	مؤثر الى حد ما	مؤثر	مؤثر جدا
أ. صعوبات تواجه المقاول لتمويل المشروع	١	٢	٣	٤	١	٢	٣	٤
ب.المقاول يواجه مشاكل توفر سيولة نقدية	١	٢	٣	٤	١	٢	٣	٤
ج. حدوث مشاكل بين المقاول والمقاولين بالباطن بسبب يتعلق بمستحقات مالية	١	٢	٣	٤	١	٢	٣	٤

قائمة (ادارة مالك المشروع):

السبب	مدى التكرار				مقياس الأثر			
	أبدا	أحيانا	عادة	دائما	غير مؤثر	مؤثر الى حد ما	مؤثر	مؤثر جدا
أ. تأجيل المالك تجهيز وتسليم الموقع	١	٢	٣	٤	١	٢	٣	٤
ب. تأخر في تسوية مطالبات	١	٢	٣	٤	١	٢	٣	٤

المقاول من قبل المالك								
ج. ايقاف مالك المشروع العمل	١	٢	٣	٤	١	٢	٣	٤
د. تأخير اصدار تغيير الطلبات (Change orders) من قبل المالك	١	٢	٣	٤	١	٢	٣	٤
ه.بطء اتخاذ القرار من قبل المالك	١	٢	٣	٤	١	٢	٣	٤
و. عدم تعاون المالك مع المقاول ما يعقد تنفيذ بنود العقد	١	٢	٣	٤	١	٢	٣	٤
ز. تأخير دفع مستحقات المقاول من قبل المالك	١	٢	٣	٤	١	٢	٣	٤
ح.افتقار سبل الاتصال وتبادل المعلومات مع الجهات الحكومية المعنية والجهات المنفذة والمتزنة من قبل المالك	١	٢	٣	٤	١	٢	٣	٤
ط. عدم وجود تنسيق مع الجهات الحكومية أثناء التخطيط من قبل المالك	١	٢	٣	٤	١	٢	٣	٤
ي. افتقار التنسيق مع الأطراف المعنية في المشروع أثناء التنفيذ من قبل المالك	١	٢	٣	٤	١	٢	٣	٤

قائمة (التخطيط المبكر والتصميم):

السبب	مدى التكرار				مقياس الأثر			
	أبدا	أحيانا	عادة	دائما	غير مؤثر	مؤثر الى حد ما	مؤثر	مؤثر جدا
أ. تغيير في نطاق العمل	١	٢	٣	٤	١	٢	٣	٤

السبب	أبدا	أحيانا	عادة	دائما	غير مؤثر	مؤثر الى حد ما	مؤثر	مؤثر جدا
ب.غموض, أخطاء, وتضارب في المواصفات والرسومات الهندسية	١	٢	٣	٤	١	٢	٣	٤
ج. حالة الموقع تختلف عن وصفها في العقد	١	٢	٣	٤	١	٢	٣	٤
د. مدة تنفيذ العقد الأساسية قصيرة جدا	١	٢	٣	٤	١	٢	٣	٤

قائمة (الأنظمة والقوانين):

السبب	مدى التكرار				مقياس الأثر			
	أبدا	أحيانا	عادة	دائما	غير مؤثر	مؤثر الى حد ما	مؤثر	مؤثر جدا
أ. عدم فاعلية غرامة التأخير	١	٢	٣	٤	١	٢	٣	٤
ب. صعوبات في اصدار تصاريح العمل	١	٢	٣	٤	١	٢	٣	٤
ج. نظام ترسية العقد لصاحب العرض الأقل	١	٢	٣	٤	١	٢	٣	٤
د. تغييرات في الأنظمة والقوانين الحكومية	١	٢	٣	٤	١	٢	٣	٤

قائمة (طبيعة الموقع):

السبب	مدى التكرار				مقياس الأثر			
	أبدا	أحيانا	عادة	دائما	غير مؤثر	مؤثر الى حد ما	مؤثر	مؤثر جدا
أ. ظروف الطقس الصعبة في موقع العمل	١	٢	٣	٤	١	٢	٣	٤
ب. محتوى وحالة ما تحت أرض الموقع (نوعية التربة, وجود خدمات أخرى, جدول مياه)	١	٢	٣	٤	١	٢	٣	٤
ج. وجود صعوبات وقيود للوصول الى الموقع	١	٢	٣	٤	١	٢	٣	٤
د. زجود اختلاف في العادات والتقاليد	١	٢	٣	٤	١	٢	٣	٤
ه. وجود تداخل وتضارب في أعمال المقاولين (بنفس الموقع)	١	٢	٣	٤	١	٢	٣	٤

قائمة (الاشراف على الموقع):

السبب	مدى التكرار				مقياس الأثر			
	أبدا	أحيانا	عادة	دائما	غير مؤثر	مؤثر الى حد ما	مؤثر	مؤثر جدا
أ. فتقار المؤهلات لعمالة الاستشاري الهندسي المشرفة على المشاريع	١	٢	٣	٤	١	٢	٣	٤
ب. تأخير اعتماد طلبات المقاول من قبل المهندس الاستشاري	١	٢	٣	٤	١	٢	٣	٤

ج. افتقار وسائل وسبل الاتصال وتبادل المعلومات بين المهندس الاستشاري والجهات المعنية في المشروع	١	٢	٣	٤	١	٢	٣	٤
د. افتقار التنسيق ما بين المهندس الاستشاري والجهات المعنية في المشروع	١	٢	٣	٤	١	٢	٣	٤
ه. تأخر المهندس الاستشاري في أداء الفحوصات والاختبارات	١	٢	٣	٤	١	٢	٣	٤
و. بطء استجابة المهندس الاستشاري لالستفسارات المقاول	١	٢	٣	٤	١	٢	٣	٤

شكرا ..... انتهت الأسئلة

ان كان لديكم أي تعليق أو اضافة بخصوص الاستبيان ... أرجو الكتابة في هذه الصفحة

Appendix H: Semi-structured Interviews (Data-Collection Phase III)

Projects in the SEC face several challenges during construction. Some of these challenges contribute to the timely delivery of projects that are authorised to develop the electricity infrastructure. These challenges were conceptually developed after applying ranking analysis of the project delay factors surveyed previously. Analysing and understanding these challenges will empower the study to suggest practical solutions to overcome these challenges. Therefore, this interview is meant to capture your thoughts and comments relevant to the analysis results. After applying Factor Analysis, the study identified the project implementation challenges and the elements forming these challenges facing SEC projects:

Owner's Contractual Commitment

Delay in progress payment by the owner

Delay in the settlement of contractor claims by the owner

Uncooperative owner with the contractor complicating contract administration

Suspension of work by the owner

- Delay in furnishing and delivering the site to the contractor by owner
- Delay in issuance of change order by owner
- Slow decision making by owner
- Difficulties in financing the project by the contractor

Owner's Communication and Coordination Effectiveness

- Owner's failure to coordinate with government authorities during planning
- Owner's poor communication with related government authorities

Owner's poor communication with contractors and consultants during project execution

Poor coordination by the owner with the various parties during project execution

Difficulties in obtaining work permits

Contractor's Project Planning and Controlling Effectiveness

No effective or realistic contingency plans in case the project is behind schedule or over budget

Ineffective planning and scheduling of the project by the contractor

Ineffective control of the project's progress by the contractor

Improper technical study by the contractor during the bidding stage

Delay in materials delivery

Consultant-related

Delay in the approval of contractor submissions by the engineer

Slow response from the consultant engineer to contractor inquiries

Delay in performing inspection and testing by the consultant engineer

Poor communication between the consultant engineer and other parties involved

Manpower Challenges and Materials Uncertainties

Low skills of manpower

Changes in material prices

Shortage of manpower

Owner's Tendering System

Owner's tendering system requirement of selecting the lowest bidder

Lack of Project Requirements Clarity

Ambiguities, mistakes and inconsistencies in specifications and drawings

Changes in the project scope

Appendix I: Extended Data Analysis Presented in Chapter 6

PDF 35 ('Delay in progress payments by the SEC')

Delay in progressing payments to Contractors was even worse before the formation of the SEC in 2000. Dr. Khoshaim, Managing Director of SCECO West before the merger with other SCECO's, explained that "if there was a problem that a contract faced, it would be not paying the contractor on time".

The Company at the time was not able to secure loans from banks because it struggled to pay the outstanding instalments it owed other banks. Therefore, it had reached the maximum limit of loan volumes. This constraint, in addition to the increasing demand for electricity, forced SCECO (based on the government's advice) to authorise and announce new project contracts without proper allocation of the required funds. This resulted in chaos when Contractors expected their payments while SCECO, in turn, expected the government to provide financial aid as promised. This financial aid was obtained either in the form of interest-free loans from the government's treasury or through the application of some political pressure on state-owned banks and financial institutes to provide more loans. This financial aid, however, was not provided in a timely manner, especially in the 1990s when the country was affected by decreased oil revenues and its direct involvement in the Second Gulf War. Public Contracting businesses suffered severely throughout the whole Kingdom.
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As a rule of thumb, the deliverables of Power Generation Projects were larger than those of Power Transmission Projects. Moreover, the deliverables of Power Transmission Projects were larger than those of Power Distribution Projects. This implies that the financial burdens on Contractors in Power Generation Projects were higher than both Power Transmission and Power Distribution Projects. Therefore, it was not a surprise to find this PDF ranked highest by PG PMs. However, it was noticed that this PDF was highly ranked by PD PMs (ranked 2nd) when compared to PT PMs (not among the highly ranked PDFs – ranked 12th). The reason was that the Project Execution Department Manager of the SEC Power Transmission business sector stepped in when a few Contractors suspended their project activities. He aggressively faced the Finance Department and explained that any delay in processing "his" Contractor payments would delay the projects. The Finance Department, on the other hand, complained about the forms not being consistent. Afterwards, the Project Execution Department Manager created a Division in which its main function was to review the Contractors' invoices. Although this presented positive project ownership by the Department Manager and minimised the effect of this PDF, the new division was filled by some Project Managers who were pulled from their assigned projects. This action, therefore, had implications for these projects as new PMs were assigned, causing disturbance to the project progress flow.

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PDF 38 ('SEC's failure to coordinate with government authorities during planning')

For example, the Planning Department was required to ensure the potential owner of the project site in the motorway, for example, (i.e. the Ministry of Transport in this case) did not have any future project plans that would interrupt the SEC's project in the future. The other reason was to issue project work permits from the relevant government authorities. Issuing project work permits from the government authorities was a pre-requisite step before initiating the project activities, otherwise projects would be interrupted by these authorities. There were different types of work permits depending on the project nature. For example, a Power

Generating Plant project that was to be built on the coast needed to have several permissions from, for example, the Coast Guard, the Environment Protection Commission and the relevant Municipality. An underground cable Power Transmission project in an urban area would need to have, for example, permission from the Municipality to secure ‘the right of way’, permission from the Traffic Police to work on the roads while being used by the public, and permission from the Transport Ministry as the owner of public motorways that were beyond urban areas. For a Power Distribution project dispersed in a rural area across a village or a settlement, work permits were required from the relevant Municipalities and Tribal Sheiks (Leaders), for example. In a few cases, the SEC had to coordinate with other public authorities, private organisations or individuals, to secure public or private right of way when required.

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PDF 37 (‘SEC’s poor communication with Contractors and Consultants during project execution’)

In many cases, poor communication could be in information misinterpretation conveyed between the two (the SEC and Contractor), as WALA (SEC) described:

> Both SEC and Contractor PMs assumed they understood each other when they didn’t!

This sentence was expressed in an identical way by JAWI (SEC). This problem could have been easily avoided by conducting review meetings more frequently to clarify ambiguous issues. Some project managers placed great value on conducting short meetings to clarify any confusion, as AJ (Contractor) expressed:

> I feel that personal interaction helps more than just communication by writing letters. It is true that things should be on record to keep the system transparent but personal interaction seems to be indispensable for communication in projects with the client.

JAWI (SEC) also appreciated having short meetings with Contractors and Consultants. These face-to-face meetings effectively resolved pending issues. The problem, however, appeared to be not having such effective short meetings as frequently as they would have liked. JAWI (SEC) said:

There is a lack of such meetings. This goes back again to the main reason which was the project load each of us has. Sometimes the technical competence of the consultant is not sound, causing the miscommunication between the three. Sometimes the contractor does not provide sufficient documents. But all these could have been solved completely in one meeting. Going through letters will result in nothing.

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PDF 39 (‘Poor coordination by SEC with the various parties during project execution’)

The subject said that during the preparation of the bidding package he noticed a few types of equipment (e.g. a mix of transformers, switchgears and SCADA) that were not technically possible to assemble. Although these specialists were working in the very same division, the poor coordination between them and the lack of a comprehensive final revision of the project design were evident. Moreover, SAR was a Contract Manager and not a technical specialist. This indicated the technical flaw did not need technical expertise for it to be noticed.

The above example revealed the SEC's poor level of coordination during the early stages of the project when the bid package was being prepared. This was valued as a significant problem that would definitely have a direct impact on the SEC-Contractor working relationship during project execution. Poor coordination in the early stages of project activities between various SEC Departments and Divisions led to unnecessary resource losses for either the SEC or the Contractor, if not both. These unplanned incidents would spark tension between the two because each would then try hard to hold the counterpart liable. ORFA (SEC) gave an example of the impact of poor coordination between the SEC Departments:

> There are examples in which contractors faced unfortunate situations because of a lack of coordination between several departments. Contractors indeed suffer to obtain reliable information. Sometimes the specification in the contract that describes the existing condition or feature of the equipment in the project site is different from reality. This happens especially in expansion projects. These mistakes can be fatal and are technically impossible to implement.

The SEC provides the project specifications and requirements for the Contractor in the bid package. ORFA (SEC), however, explicitly pointed out that the SEC protects itself contractually through an article that clears it from any liability. The Contractor is responsible for checking the site before submitting his offer even if, according to ORFA (SEC), the Contractor has false information. Having the wrong technical information would cost the Contractor dearly because, for example, the outsourced Engineering Design services would be wasted since these were based on false information and so were no longer valid.

There were cases when the project proponent who would operate the project after delivery required additional deliverables during construction. These deliverables were beyond the contract procurement list, showing another example of lack of early coordination between the project proponent and the SEC Project Specifications and Design Department. If these requested deliverables were not delivered, the project proponent managed in some cases to apply pressure on the Project Execution Department, otherwise they would refuse the project handover. As a consequence, the Project Execution Department would become abusive in terms of the pressure and methods used to force the Contractor to deliver these 'non-contractual' deliverables without compensation or the issuing of change orders. In many cases, Contractors managed to issue change orders and got compensated, but only after persuasive tactics had been used and prolonged discussions and, probably, disputes had taken place.

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PDF 21 ('No effective or realistic contingency plans in case project is behind schedule or over budget')

It could be argued that local Contractors do not have a sound methodology which can help them to identify a project risk rather than planning to respond to it. But GARI (Contractor), who worked for an international European organisation that had a visible presence in the Saudi electricity contracting market, said:

> Those who plan, if they were professionals, they do it once at the beginning of the project but without updating it.

The statement clearly shows that not updating the project plan was an invitation to lose control of the project. Projects were of a progressive nature and with the day-to-day details and with the amount of information that needed to be managed, would reduce the Contractor PM's ability to control the project. On the other hand, there was a single case when JAWI (SEC) applauded a Contractor PM's managerial and technical skills. The PM was, according to JAWI, able to identify potential project problems and deal with them before they became unmanageable even though he was managing other projects. The general feeling of all the SEC PMs, however, was that, in many cases, Contractors managed projects from a crisis point of view.

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PDF 20 ('Ineffective project planning and scheduling by Contractor')

The researcher was encouraged by ORFA's statement that 'none', according to his experience, had ever submitted an acceptable schedule. If the time schedule was realistic and approved, then it was basic when compared to the complexity of the SEC project. To further investigate this issue, the researcher went to several Contractors, but the previously addressed Contractors were very sceptical about sharing any information.

However, GARA (Contractor), a PM who worked with an international European Contracting organisation, was explicitly asked whether the Critical Path Method, for example, was used in project planning; he replied:

> Most people use Microsoft Project
>
> Researcher: Were you taught it or did you learn it through personal efforts?
>
> GARA: Personal efforts.
>
> But GARA then continued:
>
> Okay. Honestly, the majority of project managers are not experts in planning - it's mostly based on personal efforts. A project manager should have a specialised planner who just plans, plans and plans. A project manager should have a complete team whether the project is of large-size or small size. The team must consist of a project manager, project engineer (designer), civil engineer, planner and site manager. Some Contractors decide that since the project is of small size and is not worth it, they put the load on the project manager. The project manager is the project manager is the project engineer is the site manager. If someone does all that, what would you expect the work quality to be like?

The major concern was that if an international organisation did not embrace professional development training programmes for its PMs, then the situation could be much worse in local Contractor organisations.

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PDF 23 ('Ineffective project progress control by Contractor')

In addition to the above, the SEC project practice behaviour had a significant role in not allowing Contractors to control the projects effectively. GARA (Contractor) stated:

> They waste our efforts.

This was because, as GARA previously explained, a Contractor PM dealt with many internal stakeholders when the SEC PM was supposed to be the main and only communication point with the Contractor.

Achieving the project time delivery target was a mutual objective shared by the SEC and Contractors. Since the contract was of a Fixed Lump-Sum type, the risk of material price change was held by Contractors only. Therefore, the Contractors were keen to maximise, or at least maintain, their expected profit margins. As a consequence, the Contractors' PMs focused on project cost control. As GARA (Contractor) mentioned earlier, being involved with many responsibilities in their assigned projects made it difficult for the PM to focus on controlling other project aspects (scope, communication, risk, etc.). When GARA (Contractor) was directly asked about his project control performance, he said:

> Same as in planning. But people usually focus on project cost control. Someone with many responsibilities, as I said, would focus on that side only. I monitor the costs and every penny was booked for my project against the relevant Work Breakdown Structure.
>
> ***

PDF 19 ('Improper technical study by Contractor during bidding stage')

JAWI (SEC) strongly believed and asserted that the current practice of selecting and considering the lowest offer bidder was always associated with false assumptions found in their technical offers. Although technical deviations from the original requirements were normally addressed before the contract award, JAWI (SEC) indicated that the Contractors demonstrated lack of proper study and understanding of project requirements:

> In addition to our poor planning (referred to the SEC Planning Department), some Contractors don't read the contracts and they sign immediately. And then they come back to us to discuss the possibility of changing specific items (technical deviations) when they shouldn't have. They should have studied and thoroughly understood the project nature and the site limitations and signed the contract based on this.

The researcher also found that ambiguities, mistakes and inconsistencies in SEC bidding documents were of normal and common practice. These were also valued as major contributors to the Contractor's improper technical study. Changing the project site location during the bidding stage was also common practice in SEC projects. This caused bidders to repeat planning work but within a shorter time period and probably lack of enthusiasm. These issues will be thoroughly discussed in the 'SEC's Tendering System' Principal Component. Apparently, this presented an example of the complex dynamics of the PDFs and their mixed interrelationships.

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PDF 54 ('Delay in the approval of contractor submissions by the engineer')

Many other SEC PMs admitted that Consultants, in general, were exaggerating and complicating their technical decisions on the Contractor submissions. Another reasonable factor for delaying approval of the submittals was the "unmanageable load of work", as ABADI (SEC) described. As a PD PM, he reviewed the Contractors' submittals and thought, like many other participants, that the workload was a reason to delay approving or rejecting the submittals. In fact, he encouraged the Contractors to complain against him to his superior, the SEC Project Execution Division Manager, in order to find a solution. Although this example was specific to the SEC PD PMs delaying Contractors' submittals, it was argued that having an 'unmanageable load of work' was also applicable to Consultants. In other words, the workload on Consultants meant it was beyond their capacities to review Contractors submittals without delays. One of the research limitations was the absence of any qualitative data that represented the Consultants' view. However, there was supportive evidence that confirmed the observation of Consultants having workloads beyond their capacities. SCADA (Supervisory Control and Data Acquisition) systems were recently introduced into the SEC PD projects as a new project requirement. However, the SEC PD PMs did not have any technical experience with SCADA and, therefore, they could not make any technical decisions on the Contractors' submittals. On the other hand, the SEC PT projects were familiar with SCADA. Therefore, the SEC PD Project Execution Division Manager asked for the SEC PT Project Execution Department Manager's assistance. As a favour, the latter made the Consultants review SCADA drawings and designs.

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PDF 58 ('Slow response from the consultant engineer to contractor inquiries')

Consultants were not only perceived to have a slow response and thus be the cause of delay. A few of the SEC participants questioned their usefulness. The following example, narrated by JAWI (SEC), supports this perception:

> Once I was working on two projects with the same Contractor but with two different contracts. The Consultant had approved the cable specifications for one and rejected the very same cable for the other project. Both cables were identical and manufactured by the same manufacturer with the same technical specifications!

The Contractor PM, therefore, escalated the problem according to JAWI (SEC), who solved the issue in a short meeting. The unjustifiable decision would have prevented the Contractor from placing the order for both projects at a time when the copper prices were subject to fluctuations. However, the following interesting comment by AJ (Contractor) pointed out, though implicitly, that the SEC lacked a clear set of technical standards:

> Well, when you talk about Consultants who are dealing with, let's say, oil and gas industries like Saudi Aramco, those Consultants are very open, they follow Aramco's specifications and they are very professional in terms of their ability to technically convince them. But when you talk about other Consultants, let's say owners of high rise buildings, etc., they are simply trying to justify their positions. And there we do line up a lot of confrontations. They have requirements which are not an industry standard or the Consultants are not very well educated, so we have to educate them and then they use the knowledge we gave against us.

The SEC indeed had difficulties in establishing a unified set of technical standards. The SEC was originally composed of over 100 smaller companies spread over the Kingdom, and these had varying technical standards. Therefore, especially for expansion projects, it was inevitable that there would be a wide range of technical standards. In addition to this predicament, there was a general perception that Consultants were not knowledgeable, as WALA (SEC) and AJ (Contractor) stated above. AJ's (Contractor) statement that Contractors 'educate' Consultants was consistent with another Contractor PM who represented Alstom.

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PDF 9 ('Low skills of manpower')

Contractor – related

Contractors also faced this serious PDF. The extent of this PDF varied across different Contractors, but it was a phenomenon in Saudi Arabia. Skilled Contractor PMs proved to be scarce, especially in the investigated industry. ORFA (SEC) PM thought that the SEC Top Management would reduce the project cost, even if this negatively affected the Contractor's project management practice:

> The Top Management acts sometimes in a way I don't agree with. For example, we awarded a Contractor three or four projects and the SEC asked for one project manager to be assigned by the Contractor in return for reducing the contract prices. I see that as wrong!

The usual practice was that the SEC demanded Contractors to assign one PM who fully focused on just one project. The fact of having a serious shortage of PMs with engineering degrees, as per the SEC requirement, forced the SEC Top Management to allow the Contractor to manage several projects simultaneously with one PM. However, the Contractors were required to assign a permanent site manager for each project. This problem represented an opportunity for the SEC to reduce the project total cost, which was perceived by ORFA (SEC) as cost saving.

Contractors, in general, also faced troubles in hiring qualified technicians who were able to install the procured equipment at the project site. A few SEC PMs stated that some Contractors employed manpower (PMs, engineers and technicians) with false qualifications. Another SEC PM actually gave even more details. When he checked the relevant documents of the labourers, he found that some had entered the Kingdom with barber and plumber visas but had been introduced to the SEC as technicians. Discussing the explanations and root causes surrounding such a flaw in the immigration system would have negative implications for the researcher.

Consultant - related

The delay in approving or rejecting the Contractor's submissions and the slow response to Contractor inquiries were both, partially, attributed to the low skills of the hired engineers. ORFA (SEC), when asked whether their Consultant engineers lacked basic knowledge and skills, replied:

> Honestly, yes, and this caused problems and delays by their being incapable of making decisions at the right time as a result of their weak background. Sometimes (laughs), in fact many times, they mock being knowledgeable and we reach the point where troubles are escalated by the Contractor for rejecting their submittals and we get convinced these shouldn't be rejected. They also unjustifiably insist on things that are nonsense. They don't want to take the risk.

SAF (SEC) PM also supported the above statement when asked whether their outsourced Consultants delayed the Contractor submittals as a result of their low skills:

> Yes it happens. There are technical and managerial weaknesses in them and in supervision as well.

JAWI (SEC) agreed with the above and described the Consultants' skills as average and below average, and continued:

> Consultants don't properly develop because they (SEC) outsource cheap skills and we award our projects to Consultants on the lowest price basis not on the qualification basis.

Interestingly, although JAWI represented the SEC, he said 'they' when he referred to the SEC. This indicated a tone of disagreement towards outsourcing Consultants based on the lowest bidder. However, these Consultants were paid on an hourly rate basis, which meant any project delay would cost the SEC more money.

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PDF 3 ('Changes in material prices')

Besides these external forces affecting the material prices, the Contractors were, in some cases, informed by the SEC they should procure materials in quantities that seemed to have been underestimated in terms of carrying out related project work. This caused disputes in many cases as the material prices were fluctuating, and placing any additional orders meant additional costs for the Contractor. This problem occurred repeatedly in the PD projects, as HM (SEC) described:

> We used to have unrealistic quantities estimation from the planning (the SEC Planning Division – PD) causing inconvenience to the contractors as they commit to the suppliers with the estimated quantities while the actual quantities during execution are different. The difference could reach up to 30 - 40% while the normal practice should be around plus or minus10%.

The main reason for not having accurate quantity estimations for the required materials was because the project site was surveyed years before the project execution. This case was common, especially in rural electrification projects. The Planning Division surveyed the project areas to estimate the required project budget. However, project budgets were usually allocated a few years later. By the time the surveyed areas were normally developed, these areas had increased populations. This indicated more customers needed to be connected to the service. This problem was solved by the Project Execution Division Manager after 4-5 years of repeating the same problem. He influenced the decision not to announce a project before a recent project site survey had been conducted in order to better estimate the quantities.

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SEC's Tendering System

Prequalification

The above presented an apparent weakness in the SEC prequalification system. The SEC Contracting manual explicitly states that Contractors should have the available financial, manpower and equipment resources to be invited for any project bidding. However, there was no established mechanism to objectively measure these requirements. Instead of examining Contractors' available resources by conducting a comprehensive check of their financial abilities (bank statement review, for example), manpower availability (human resource manifest or labour supply contract reviews for example) and equipment availability (visiting warehouses storing the equipment or other projects under closure), the prequalification process was limited, rather, to screening new entrants by questioning their previous project experiences. This limitation, however, revealed an acknowledgement from the SEC concerning the difficulties and shortages surrounding the Contracting business in Saudi Arabia. Many of these Contractors were involved in public projects in addition to the SEC ones and, therefore, understandably, project resources were stretched and scarce.

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PDF 41 ('Ambiguities, mistakes and inconsistencies in specifications and drawings')

An illuminating interview was conducted with Dr. Khoshaim, ex-Managing Director of SCECO West before the company was merged with today's SEC. The interview led to the feeling that the 'Engineering Management Department' at the time was seriously struggling to set project equipment specifications. The Department was concerned with project planning, setting its specifications and design, and managing its construction and execution. Relevant to this particular problem, Dr. Khoshaim said:

> Other than these there shouldn't be any barriers to project progress. If the Contractor meets the specifications and these were clear then everything should be fine. I can tell you now that the electricity companies SCECOs are professional and have a clear set of specifications for the procured equipment. These specifications were not collected arbitrarily based on a selection of the best features from several manufacturers' standards then collect all these into one piece. This custom made equipment will be too expensive and it's silly to have it all. Now it is much more improved.

As can be sensed from the above, the subject implies that SCECO 'used' to have a mixed set of specifications in which the SCECO engineers selected some 'desired' features from several manufacturers. These selected features were chosen based on different standards. On this basis, the SCECO engineers demanded that the Contractors at the time should procure equipment according to these 'pick and mix' features based on several different standards. In another part of the interview, the subject mentioned that

> We used to be not so clear about our specification needs.

Although the following was mentioned in a different context, this could explain how persistent the SCECO engineers were:

> The Contractor placed orders for equipment with specifications we did not agree on. He deviated to save money.

This, of course, created a climate of mistrust with SCECO, but the researcher feared that the Contractor might, in many cases, be in a position where he ‘had’ to place orders for the equipment otherwise the manufacturer would quote additional lead time for equipment manufacturing and delivery. Over specifying and over engineering products and equipment certainly prolonged and extended project delivery time. This was especially true when Contractors continuously made an effort to influence the SCECO Engineering Managing Department to set realistic specifications and choose a specific standard to follow. Therefore, the Contractor was forced to place the order for the equipment while he was certain that SCECO would not easily accept it.

The research was more concerned with contemporary project issues in the SEC but analysing the behaviour development was necessary to examine the extent of improvement of the controversial set of engineering specifications and standards adopted by the SEC. At the time of the research, Dr. Khoshaim trusted that the Company was mature when it came to specifying the procured project deliverables and activities. The following example was narrated by HM (SEC):

> We used (in 2006) to have overly sophisticated design requirements for our poles (used for overhead line distribution networks, especially in rural areas). The main components of poles had specifications that caused disruptions in the manufacturing process. We (both the SEC Project Execution Division and Technical Support Division) met to agree and choose then unify the standards of the most important components. Moreover, we became more flexible with the auxiliary components and accessories. This reduced the pressure on the Contractors when placing orders with the manufacturers and significantly reduced the cost on us. This made it more predictable for the Contractors to better estimate their offers when bidding.

According to the subject, Contractors very much appreciated the initiative and, apparently, it was a win-win result. There were many areas where the SEC could develop its project contractual practice, especially those relevant to the bidding package. Improving the bidding package quality would result in a more consistent project contract and, hence, a more stable contractual relationship with the Contractors.