# Influence of Cognitive Bias on Decision Making in Mega Projects

تأثير الانحياز المعرفي على إتخاذ القرار في المشاريع الضخمة

**by**

**WALEED SALEM ALNUAIMI**

**A thesis submitted in fulfilment**

**of the requirements for the degree of**

**DOCTOR OF PHILOSOPHY IN PROJECT MANAGEMENT**

**at**

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Abstract

Mega projects is an important topic in social sciences as it showcases the achievements attained by a group of people in a bid to advance the trend in a society through critical official transformation. Over the years, scholars, specialists, legislators, and the public have developed profound concern regarding mega projects exploring its characteristics and most importantly the consequences of these projects. In spite of mega projects yielding amazing outcome and benefits in the respective environments where they are executed, majority of research shows that the performance of projects is extremely below par especially in relation to expenses and time overruns which have been attributed to the features of mega projects which include complexity, wide scope, extended duration, huge funds and environmental settings that prompts increased risks to mega projects than other projects consequently increasing the rate of cost overruns.

The main reasons for cost overrun have been clustered into three groups namely technical, optimism bias and strategic misrepresentation. Since mega projects are increasing in size and number, and their poor performance has been consistent despite various proposals suggested based on project management best practices that have mainly focused on the technical element of implementing mega projects, the performance in mega projects has not improved prompting this study to focus on optimism bias and strategic misrepresentation where if optimism is exceeded, it is termed as over optimism and leads to cost overrun due to significant underestimation of costs. The study builds on the view that cognitive biases have an influence of on cost overrun either directly or indirectly through decision making. Cost overruns are mainly influenced by decisions relating to costs and those that relate to risk. The study checked the influence of 12 cognitive biases that are controllability,

availability, anchoring, conformation, cognitive dissonance, dread, familiarity, hindsight, scale, representativeness, optimism and venturesomeness on decision making (cost and risk) and cost overrun due to over optimism by developing a predetermined questionnaire using these factors and distributing it to decision makers in projects. Additionally, the influence of demographic attributes on cost overrun was also checked. 101 responses were received and analyzed through variance analysis, correlation, association analysis, and hierarchical regression.

The association analysis which generated the key findings of the study indicated that work experience, controllability, dread, and cost decision making have significant influence on cost overrun due to over optimism while other factors were not significant. On the other hand, availability, anchoring, dread, and familiarity were found to significantly influence cost decision making, the other biases had no significant influence on cost decision making implying these biases have an influence on cost overrun through decision making.

The hierarchical regression showed only work experience had an effect on both cost decision making and cost overrun while all other cognitive biases showed no impact indicating the presence of all biases at the same time does not have an influence on cost overrun but when considered individually which reflects high degree of the bias, controllability and dread biases have a direct influence on cost overrun due to over optimism whereas availability, anchoring, dread, and familiarity biases influence cost overrun through cost decision making in mega projects. The study proposes monitoring of all cost decisions in relation to these biases to ensure the biases do not impact on the project’s costs and hence do not influence cost overruns.

## مجرده

المشاريع الضخمة هي موضوع مهم في العلوم الاجتماعية حيث تعرض الإنجازات التي حققتها مجموعة من الناس في محاولة لدفع الاتجاه في المجتمع من خلال التحول الرسمي الحاسم. على مر السنين، اكتسب العلماء والمتخصصين والمشرعون والجمهور قلقًا عميقًا بشأن المشاريع الضخمة التي تستكشف خصائصها والأهم من ذلك عواقب هذه المشاريع. وعلى الرغم من المشاريع الضخمة التي تحقق نتائج وفوائد مذهلة في البيئات المعنية حيث يتم تنفيذها، فإن غالبية الأبحاث تظهر أن أداء المشاريع أقل من المستوى المطلوب خاصة فيما يتعلق بالنفقات والتجاوزات الزمنية التي تعزى إلى ملامح المشاريع العملاقة التي تشمل التعقيد والنطاق الواسع والمدة الطويلة والأموال الضخمة والاحوال البيئية التي تدفع إلى زيادة المخاطر على المشاريع العملاقة من المشاريع الأخرى وبالتالي زيادة معدل تجاوز التكاليف.

وقد تم رصد الأسباب الرئيسية لتجاوز التكلفة في ثلاث مجموعات هي: التحيز التقني والتفاؤلي والتحريف الاستراتيجي. وبما أن المشاريع العملاقة تتزايد في حجمها وعددها، وكان أداؤها الضعيف متسقاً على الرغم من المقترحات المختلفة استناداً إلى أفضل الممارسات لإدارة المشاريع التي ركزت بشكل رئيسي على العنصر التقني لتنفيذ المشاريع العملاقة، فإن الأداء في المشاريع العملاقة لم يتحسن مما دفع هذه الدراسة إلى التركيز على التحيز التفاؤلي والتحريف الاستراتيجي حيث إذا تم تجاوز التفاؤل (ويسمى التفاؤل المفرط) يؤدي إلى تجاوز التكلفة بسبب الاستخفاف في تقدير التكلفة. وتستند الدراسة إلى الرأي القائل بأن التحيزات المعرفية لها تأثير على تجاوز التكلفة إما بشكل مباشر أو غير مباشر من خلال صنع القرار. وتتأثر تجاوزات التكلفة أساسا بالقرارات المتعلقة بالتكلفة والقرارات المتعلقة بالمخاطر. وفحصت الدراسة تأثير 12 تحيزًا معرفيًا تتمثل في إمكانية التحكم والتوافر والرسو والتوافق والتنافر المعرفي والرهبة والألفة والإدراك المتأخر والحجم والتمثيل والتفاؤل والمغامرة على صنع القرار (التكلفة والمخاطر) وتجاوز التكلفة بسبب التفاؤل المفرط من خلال تطوير استبيان محدد مسبقًا باستخدام هذه العوامل وتوزيعه على صناع القرار في المشاريع. وبالإضافة إلى ذلك، تم أيضا التحقق من تأثير السمات الديمغرافية على تجاوز التكلفة. تم تلقي 101 استجابة وتحليلها من خلال تحليل التباين والارتباط وتحليل الاقتران والانحدار الهرمي.

وأشار تحليل المصادقة الذي أسفر عن النتائج الرئيسية للدراسة إلى أن الخبرة العملية، والقدرة على التحكم، والرهبة، واتخاذ القرارات المتعلقة بالتكلفة لها تأثير كبير على تجاوز التكلفة بسبب التفاؤل المفرط في حين أن عوامل أخرى لم تكن كبيرة. ومن ناحية أخرى، وجد أن التوافر والرسو والرهبة والألفة تؤثر بشكل كبير على اتخاذ القرارات المتعلقة بالتكلفة، ولم يكن للتحيزات الأخرى تأثير كبير على اتخاذ القرارات المتعلقة بالتكلفة، مما يعني أن هذه التحيزات لها تأثير على تجاوز التكلفة من خلال اتخاذ القرارات.

وأظهر التراجع الهرمي أن الخبرة العملية فقط كان لها تأثير على كل من اتخاذ القرارات المتعلقة بالتكلفة وتجاوز التكلفة، في حين أن جميع التحيزات المعرفية الأخرى لم تظهر أي تأثير يشير إلى وجود جميع التحيزات في نفس الوقت ليس لها تأثير على تجاوز التكلفة ولكن عندما ينظر إليها بشكل فردي مما يعكس درجة عالية من التحيز والسيطرة والتحيزات المخيفة لها تأثير مباشر على تجاوز التكلفة بسبب الإفراط في التفاؤل في حين أن التوافر ، والرسو، والخوف، وتحيزات الألفة تؤثر على تجاوز التكلفة من خلال اتخاذ قرارات التكلفة في المشاريع الضخمة. وتقترح الدراسة رصد جميع قرارات التكلفة فيما يتعلق بهذه التحيزات لضمان عدم تأثير التحيزات على تكلفة المشروع وبالتالي عدم التأثير على تجاوزات التكلفة.

# Dedication

This thesis is dedicated to

My wonderful Father who believe in the richness of learning and supported my journey all the way through.

My Mother who raised me to be the person I am today.

# Acknowledgment

I would like to express my special appreciation and thanks to my Director of Studies Professor Dr. Halim Boussabaine, you have been a tremendous mentor for me. I would like to thank you for encouraging my research and for allowing me to grow as a researcher. Your advice on both research as well as on my career have been priceless. I would also like to thank my committee members for letting my defence be an enjoyable moment, and for your brilliant comments and suggestions, thanks to you.

A special thanks to my family. Words cannot express how grateful I am to my mother, and father for all of the sacrifices that you've made on my behalf. Your prayer for me was what sustained me thus far. At the end I would like to express appreciation to my beloved wife who spent sleepless nights with me and was always my support in the moments when there was no one to answer my queries.

Table of Contents

# Chapter One: Introduction

The ensuing chapter is the introduction chapter. The section presents background information from research studies on mega projects. Further, the problem under study is put into context in the problem statement. The chapter also discusses the questions it aims to answer, the research aims and objectives. The scope of the research included in this chapter discussed the extent of the investigation with regard to the wider realm of research. Further, the significance of the study and its purpose are also presented to elaborate the underlying motivations and enlist what this study seeks to achieve. The final section of the first chapter details the structure of the entire thesis including the on-going chapter.

## *1.1 Background of Study*

Mega projects are among the greatest thought-provoking occurrences in engineering as they epitomize important accomplishments by a group of stakeholders to enhance the advancement and trend in society including the gathering of shared effort to introduce vital official transformation (Söderlund, et al., 2017). These projects have been labelled as trait making in that they are created with the aspiration to upgrade the organization of the public not like other small projects that are termed as trait taking because they are structured to be incorporated in the current structures and have no intention of amending the present structures (Flyvbjerg, 2008). Over the years, scholars, specialists, legislators, and the public have developed profound concern regarding mega projects and the paybacks that these projects generate could be the motivation behind the increased worry (Erol, et al., 2018).

The word ‘mega project’ started being used in 1976 (Li, et al., 2018) and theoretical information has expanded radically in the last two decades (Pollack, Biesenthal, Sankaran and Clegg, 2018). Halder (2018) simply defined mega projects as gigantic infrastructure missions that utilize extensive funds outlay and with many participants. Historically, the term “Mega” was initiated from the Greek term “Megas” signifying big or massive but arithmetically, mega means “million”, thus any huge project with a budget of $1 million or another currency could be labelled as a mega project (Halder, 2018). Even though the amount of money spent on mega projects could portray the extent of the project, this arithmetical narrative was found inadequate in explaining mega projects especially when taking into account the complexity in managing the projects and the revolutionary consequence these projects bring along leading to other scholars like Pollack et al. (2018) to propose additional measurements relating to management that include company complexity, vagueness, drive or motivation, the politics and linked risks since these factors may show that some lower cost projects could be levelled as megaprojects. On the other hand, Pitsis, Clegg, Freeder, Sankaran, and Burdon (2018) recognised seven elements of mega projects that differentiate mega projects to large projects which are project scope, time, the possibility of threats and fears of unclear scenarios, diverse primary participants, and law associated matters. There are many definitions of mega projects expressed by various scholars but the broadest description of megaprojects that incorporate most essential elements can be restated as mega projects are huge-scale, complex schemes approximated to cost US$1 billion or over that is undertaken over a period of several years, integrates both public and private concerned parties, and have effect on the larger populace and target to create major transformations in the society (Flyvbjerg, 2017).

Megaprojects include making of airstrips, automated railway configurations, highways, and others, superstructure like hospitals, and extravagant building structures among others, water assemblies such as dams, ports and others, energy creations like power generation plants, oil and gas exploration etcetera, finally, mega-events that include Olympic games, World Cups, World Expos, etcetera (Erol et al., 2018). Also, mega projects consist of projects under information technology systems, aerospace projects, weapons systems, and inexpensive scientific exploration like the investigation of the human genetics though many of executed mega projects are in hydroelectric amenities, nuclear power plants, and huge communal transport (Misic. 2017). Söderlund, Sankaran, and Biesenthal (2018) included the construction of extraordinary stadiums and museums as mega projects.

Many countries use megaprojects as a way of nation-wide upgrading and in emerging countries, these projects are implemented to enhance radical economic progress through supporting supposed public and infrastructural developments (Halder, 2018). The mega project is an important area under construction management due to its credit in impacting on state economy progress through city growth, reducing unemployment, and initiation of various businesses by developing infrastructure (Erol et al., 2018). These projects are progressively being implemented as the desired supply chain for products and services in almost every company and industry hence developing and sustaining infrastructure is among the core activities to the economic progress of a nation for example, the Panama Canal contributes a substantial amount to the nation's gross domestic product (GDP), another is the Dubai international airport which has the most activity in the globe and contributes 21% of employment in Dubai and 27% of Dubai's GDP (Flyvbjerg, 2014). In Hong Kong, the MTR has less impact to the environment than other forms of transport added to its speed has provided a foundation for the public to easily commute from nearby towns around the city to the city (Flyvbjerg, 2014). In addition, megaprojects can protect lives, for instance, the sewerage and sources of water structures are designed to prevent illnesses like cholera (Garemo, Matzinger and Palter, 2015). More, a bigger proportion of Netherlands would be submerged in water if the North Sea Protection Works project was not undertaken as it protects the low laid land setting for the nation (Garemo et al., 2015).

Worldwide expenditure on mega projects was projected at more than 7% of the overall GDP, signifying the largest funding deed in history (Flyvbjerg, 2014). Likewise, as noted in Söderlund et al. (2018), megaprojects are anticipated to upsurge intensely to nearly 25% of the worldwide GDP in the subsequent decade and also claim that projects revolving around climate change issues, managing enormous data, and preventing and unravelling human distresses like illnesses will become common mega projects. Quite a number of mega projects amount to the gross domestic product (GDP) of some states and other mega project costs are so large to be compared to any economic or asset outlay value, for example, the globe's biggest megaprojects being the Joint Strike Fighter aircraft project and China's high-speed rail mission that can be quantified in trillions of dollars (Flyvbjerg, 2017). As per the forecasts for infrastructure development required to attain the global constantly rising demands for economic progress and enhancements assessments by McKinsey, the investigation indicated that the globe warrants nearly US$60 trillion on infrastructure development by 2030 to sustain the projected GDP upswing (Garemo et al., 2015). Correspondingly, reviews from the Organisation for Economic Co-operation and Development (OECD) on the world's infrastructure funding required to continue advancing as anticipated, surpasses the value noted by McKinsey (Mirabile, Marchal and Baron, 2017).

A common agreement pronounced by the majority of prominent academicians is that mega projects are increasing in number, magnitude, and dimensions (Söderlund et al., 2018), For instance, the highest structure in 1930 was New York's Chrysler Building at nearly 320 meters but from 1998, the highest structure is in a developing nation at Dubai, known as Burj Khalifa at approximately 830 meters demonstrating an upward trend of around 160% in the last century (Flyvbjerg, 2017). Even more, advancement is observed in bridge construction was the lengthiest bridge has progressed by 260% within a similar time span. When mega projects are evaluated using amount and size, infrastructure projects have improved by an average of 2% every year (Flyvbjerg, 2017). The information, communication, and technology (ICT) sector have observed the highest growth at 1600% in coding lines at Microsoft Windows (Flyvbjerg, 2017). Mega-events have not been exempted from the current growth in size and magnitude as the costs associated with hosting the FIFA World Cup and Olympics have been varying on an incremental way, for example, the FIFA World Cup of 2002 prompted South Korea to devote $2 billion while Japan spent $4 billion (Griffin, 2015), the 2010 World Cup in South Africa cost $7.5 billion, the 2014 World Cup in Brazil cost an estimated $14 billion whereas the latest World Cup for 2018 in Russia has been estimated at $20 billion (Müller, 2017). Generally, the growth in mega projects is worth noting and in order to understand anything related to mega projects, it would be important to examine the driving factors behind megaprojects.

Around the globe, nations have diverse formal organizations and degree of economic progress but the problems concerning mega projects are the same which encompass of pronounced threats and vagueness, cost differences that incorporates undervaluing and overruns, poor involvement of the public, absence of openness, community and environment effects leading to the growing attention in mega projects preparation and administration due to the massive capital required to undertake these ventures coupled with the wide and varied risks and most importantly, the outcome of mega projects (Zeković, Maričić and Vujošević, 2018). In order to efficiently observe the outcome of mega projects, it is important to understand the performance measures based on the success expected and even though managing projects is a common subject among researchers, the description of project success has been a contentious issue which is chiefly attributed to the different standards for evaluating project success as applied by diverse stakeholders and researchers, and as such project success may be gauged in dissimilar ways depending on the preference of the stakeholder (Hammond, 2018). Project managers, workforces, high-level managers, operational managers, CEO, directors, contractors, merchants, clients, and other associates perceive project success differently (Ramos and Mota, 2016). For instance, a project may be termed as successful by senior managers but may not necessarily be perceived successful by workers since the workforces had gone the extra mile of working for more hours per day including weekends when they were intended to rest (Project Management, 2016). In the same context, the workers may perceive the project as successful because they managed to complete what was planned but to the sponsor of the project, the project may be a failure because the project took more time than scheduled and the cost was beyond what was planned negatively affecting the financial position of the sponsor. Hence, diverse stakeholders look at project success in dissimilar ways (Beleiu, Crisan, and Nistor, 2015).

Similarly, Al-Shaaby and Ahmed (2018) demarcated success as the contrary or reverse of failure where a certain social standing and accomplishment of a goal is experienced implying there is no single way of measuring success in projects, numerous dimensions are used in different settings. According to Shojaie, Shadalooie, Khalili-Damghani, and Pakzad (2016), project success is when the managing of the project and the outcome is successful. Bodicha (2015) elaborates projects success in terms of being completed as per schedule, within the cost stipulated, and satisfies the sponsor's stated quality. Al-Shaaby and Ahmed (2018) observed project effectiveness in three scopes, performance, outlooks of the project's members, and behavioural outcomes. In addition, the scholars noted the importance of time, cost and quality, and proclaimed the importance of technical success such as introducing a new product that meets the pricing mark. Other corporate dimensions of project success include brand image and economic success (Al-Shaaby and Ahmed, 2018). More, project success should be evaluated based on the efficacy of the project that includes direct and corporate success, impact on the sponsor, and prospect organization (Al-Shaaby and Ahmed, 2018).

With the great deviation in describing projects success and the view that the project's absolute level of success or failure may differ with time, Goatham (2015) classified project success into five extents which he placed in layers and labelled them as tiers as illustrated below.

Tier 1: A project is reflected as a success when it is executed within the planned cost and time.

Tier 2: A project is deliberated as a success when the project scope has delivered what was agreed.

Tier 3: A project is termed as a success when it meets the standards planned and anticipated quality criteria.

Tier 4: A project is reflected as a success when it meets the corporate and environment needs.

Tier 5: A project is successful when it has been able to wholly accomplish the desired results.

Further, Goatham (2015) pronounced that the incongruity among academicians and professionals with regards to project success is caused by the interlinked way of confirming success and failure which are on tier 4 and 5 of this project success description leading to the layers to be divided into two sections namely, project management success that is concerned with implementing the project competently on time, within the cost planned, extent, and quality, while the second section labelled project success, encompasses of the value created after the close of the project.

Al-Shaaby and Ahmed (2018) concluded that the most important elements of project success are scope, quality, time, and cost. Also, Bodicha (2015) found cost, scope, time, and quality are generally integrated into projects and should be a baseline for evaluating project success even though the actual measure is the view of the public which expects project managers to do well in all aspects of the project. Many mega projects have provided the results as anticipated initially and many are still in the process of expansion but also many have exceeded their planned cost and scheduled period, for example, the Panama Canal, Dubai airport including the super effective MTR have both cost and time overruns (Garemo et al., 2015).

Cantarelli, van Wee, Molin, and Flyvbjerg (2012b) research found that cost overruns increase by 5% per year extended implying schedule has an impact on cost overrun. Adam et al. (2015) noted that the scheduling of the project affects the possibility of cost overruns to arise. Musirikare and Kule (2016) revealed that projects postponement is directly proportional to cost overruns in that the more the project lasts beyond its expected schedule, the greater the cost overruns, hence avoiding time delays would definitely control the cost overruns and hence this study considers the time overrun not as a resultant outcome of mega projects but as a factor causing cost overrun. The consequences of cost overruns are severe and may lead to various detrimental effects on the national economy such as misuse of huge public funds through creation of 'white elephants' that resulted from abandonment of the project due to lack of enough funds to complete the project, increased cost escalations from obtaining more funds, in some cases, renegotiation of contract terms, contractual disputes, litigation and arbitration, negative response from the society, and loss of opportunity by using funds which could have been directed to other economic development objectives (Gbahabo and Ajuwon, 2017). While scope and quality have been found important in gauging project success, the impact of costs overrun on the hosting nation is more extended compared to the impact of scope and quality, and also measuring and comparing project scope and quality can be difficult task thus this study focuses on cost overruns in mega projects not only because of the reasons stated but because the issue of cost overruns has never progressed in spite of the overwhelming research undertaken to reduce or eliminate this quagmire (Ahiaga-Dagbui et al., 2015).

Cost overrun has simply been defined as the extra cost spent on a project beyond the approximated cost which is measured in the hosting nation's currency against unwavering prices and a steady reference point (Flyvbjerg et al., 2018). Over the past several decades, numerous scholars have investigated the issue of cost overruns in diverse sectors, periods, nations, regions and in specific projects, and the findings show that there has not been any improvement in the rate of cost overruns over the years despite the majority of research in this area have highlighted cost overrun as a major problem surrounding the execution of mega projects and this can be observed by exploring previous studies and current studies while specifically looking at the rate of cost overrun in the different studies.

In the infrastructure sector, one of the previous and widest cost overrun investigation in infrastructure sector was conducted by Flyvbjerg, Bruzelius and Rothengatter (2003) which included data from around the globe, specifically, in five continents, 20 states and incorporating both emerging and developed economies for projects ranging from the 1920's to 1990's. The study discovered that many mega projects surpass their original costing by around 50% to 100%, and some even by over 100% showing the substantial degree of cost overrun especially with the total cost of these projects being acknowledged to be significantly high compared to other projects, these cost overruns can become disastrous to ambitious nations which want to quickly progress the living conditions of its populace. In the study, there were two infrastructural mega projects that were noted to have extremely exceeded their cost included the Channel Tunnel and the Denver International Airport. The Channel Tunnel was completed in 1994 and initially planned at a cost of £4.7 billion but the project exceeded its costs by 80%, whereas the Denver international airport that was planned at a cost of $5 billion had costs overrun amounting to nearly 200% (Flyvbjerg et al., 2003).

Other studies conducted in various parts of the globe include Lee (2008) who undertook an investigation on the mega transportation projects in Korea that encompassed of road, rail, airport and seaport projects. The study found that all rail projects and the majority of road projects had cost overruns not more than 50%. Cantarelli, Molin, van Wee and Flyvbjerg (2012a) investigated the cost performance of mega transportation projects in the Netherlands and found the average cost overruns to be slightly over 16%. Extending this study in Cantarelli, van Wee, Molin, and Flyvbjerg (2012b) where statistical tests were conducted such as Binominal test, Paired sample T-test, F-test, and One-way ANOVA, the study realised that average cost overruns for fixed links was nearly 22%, 19% in the roads segment and 11% in the railway projects. Park and Papadopoulou (2012) analysed 35 transportation projects in Asia that consisted of harbours and ports, roads, bridges and subway projects and discovered the rate of cost overrun was not constant and ranged between nearly 1% to 100%.

More recent studies on cost overruns in infrastructural mega projects show similar findings from the previous literature. For example, Cantarelli and Flyvbjerg (2015) studied the cost overruns in various regions of the world. The findings showed that in Europe,  in 23 Rail projects, the average cost overrun was 34%, in 15 fixed links projects, the average cost overrun was 43% , and in 143 road projects, the average costs overrun amounted to 22% and for all 181 projects, the average cost overrun was 26%, In North America, 19 rail projects were analysed and the average cost overrun was at 41%, for 18 fixed links projects, it was 26%, and for 24 road projects, it was found to be 8%, all 61 projects having an average cost overrun of 24%. In the same study, the other regions were grouped together, and the findings showed that rail projects have higher cost overruns at 65% for other regions compared to Europe and North America. The study also consolidated the findings and found the globe’s average cost overrun for the 58 rail projects amounted to 45%, for the 33 fixed links projects checked, it was found to be 34%, and for the 167 road projects examined, it was 20%. Sarmento and Renneboog (2016) scrutinized cost overruns in public infrastructure projects in Portugal and found the average cost difference is at over 20%. In the same year, Flyvbjerg, Hon, and Fok (2016) scrutinized 863 roads projects around the globe and found the average cost overrun was at 20%. Flyvbjerg et al. (2016) also analysed 25 road projects in Hong Kong and found varied average cost overrun, in some it was 11%, others it was 6% and remarkably, for some it was cost underrun at -1%.  In another more detailed study looking at Hong Kong is the research by Huo et al. (2018) who examined the expenditure performance of mega transportation infrastructural projects in Hong Kong by collecting data and adopting statistical techniques on 57 projects in road, rail, bridge, and tunnel for the years between 1985 and 2015. The findings in the study showed that infrastructural projects in Hong Kong had a cost overrun of close to 40%, and in the different categories checked, the average excess cost for rail projects was around 35%, for road projects it was slightly above 32%, and nearly 38% for fixed link projects which consists of bridges and tunnels among others.

The issue of cost overruns is not only in infrastructural projects as other sectors are experiencing the same problem of cost overruns over the many years. Jergeas (2008) examined the frontend loading of Alberta mega oil sands projects and noted that in spite of the management trying to lessen costs by reducing allowances, the costs for the various projects continued to rise above the allowances. Another all-encompassing and more recent study in the energy sector specifically, oil and gas megaprojects, was conducted by Olaniran, Love, Edwards, Olatunji and Matthews (2015) whom looked at on-going projects as at 2015 in the globe and discovered the average cost overrun for all projects checked was at over 60% which is quite significant. This shows that in the energy sector the present rate of cost overruns for projects is worse than in infrastructural projects.

In mega-events, the scenario is still the same. Flyvbjerg, Stewart, and Budzier, (2016) noted high-cost overruns from the implementation of the 2006 Winter Olympic games in Turin, Italy and estimated it at 80%. Pastorelli (2014) indicated that the event had an initial budget of 500 million euros, but the mega sports event cost 3.5 billion euros. One of the major setbacks from the event was the creation of White Elephants, whereby, after 4 years, in 2010, the Ex Olympic village developed for the participants was neglected and abandoned (The Guardian, 2016). For the 2010 World Cup in South Africa, numerous challenges have been associated with the event. High cost overrun was observed due to the misappropriation of funds and led to a serious financial breakdown and economy stagnation caused by unmanageable consumption due to deteriorating production and attributed to scarcities in local supply prompting an increase in unmaintainable importation heightening the risk of more foreign debts (Chukwuebuka & Chinedu, 2014). More, a study by Humprey andFraser (2016) on the utilization of these stadiums show very low usage during the ex-post period leading to the “White Elephants” dilemma hence the event has been seen to cause negative legacies especially with the increase in debt.

Andrić et al. (2019) summarized the cost overruns for various regions as follows; Asia has an average cost overruns of almost 10%, smaller than the global average at 28%, in the Netherlands it is 16.5%, Hong Kong is slightly more than 39%, in Europe 26%, North America 24%, and in Asia, the highest is in East Asia at more than 22%. More, in rails projects, the lowest cost overruns are in the Netherlands at nearly 11%, followed by Asia at slightly over 21%, then Europe at slightly above 34%, North America at almost 41%, and Hong Kong at over 58%, and in roads projects, cost overrun is at over 10% in Asia, over 18% in the Netherlands, over 22% in Hong Kong and Europe (Andrić et al., 2019). The rate of cost overrun is not reducing and the on-going inclination on big and bigger projects continues to increase the risk and complexity of managing these projects resulting to failed or unproductive undertakings (Adam et al., 2015). As megaprojects are fond of cost overruns, they jeopardize the financial stability of firms and most troublingly are that they can detriment the economic setting of hosting state (Erol et al., 2018).

The 'Oxford Handbook of Megaproject Management' is a book compiled by more than 40 specialists in the academic field of project management and revised by Bent Flyvbjerg, a specialist in project management, who particularizes the 'Megaprojects Paradox' which confirms the need for megaprojects in economic development in both public and private sectors including the increase in size and number of mega projects but the paradox is, how is it that the performance in mega projects has notably been inefficient in terms of additional expenses, postponements, and deficiency on the outcome expected and has not progressed over the many decades in existence while demand for bigger projects has constantly increased. The organizers and executives of mega projects are trapped in this dilemma as the mega projects to meet the intended purpose while exceeding cost indicating problems, but mega projects are still being deliberated, approved and executed (Misic, 2017).

A cognitive bias is a way of perceiving information in reasoning and which affects a person's judgment and decision making (Cherry, 2019). Some of such biases are connected to a person's experiences and preferences. Cognitive biases cause a person to judge and make decisions which diverge from rationality. According to Winterfelt (2015), it is a systematic incongruity between the supposedly correct answer in a task that involves, given by a formal normative rule, and the actual answer of the expert or the person making the decision. This type of perception takes place when people attempt to carry out the interpretation of information in their surroundings. It is a consequence of when the brain tries to make information processing simpler. These biases enable a person to see sense in their environment and the world.

Before making a decision, the collected data needs to be analysed. Once collected, the data needs analysis. Cognitive errors that are made in analysis normally arise out of false associations and probabilistic way of thinking which is faulty (Coaker, 2015). As much as these errors occur naturally, some are systematic and can be  Decision makers are likely to cause distortion, modification and even active neglecting information that have been collected, not realizing it, following various biases. Isolating data and then analysing it may cause several biases. To understand better the impact of cognitive bias in decision making, it is paramount to look at some specific types of cognitive biases and how they affect decision making.

An example of cognitive biases is confirmation bias which is best explained through misinformed opinions of doctors during diagnosing of patients; Groopman(2010) points out that a preconceived opinion about the condition of a patient may lead a doctor to incorrectly diagnose a patient. In the same light, confirmation bias is seen as a threat to decision-making in Megaprojects. Groopman(2010) claims that the above-hypothesized doctor may ask questions that aid in the confirmation of the preconceived state of the patient; similarly, project managers may make a decision from faulty in information to mimic the past success that may fail in the risky environment in which mega projects operate.

## *1.2 Problem Statement*

Cost overruns and postponement of megaprojects are normal news being broadcasted all over the globe where excess millions of monies are utilized and worldwide research has indicated that the larger the project, the higher the probability of postponement and cost overruns (Siemiatycki, 2015). In a study by Cantarelli et al. (2012b), cost overrun was found to be affected by the size of the project. Shrestha, Burns and Shields (2013) investigation of over 360 public construction projects in Clark County, Nevada discovered that the bigger the size of the project the higher the number of cost overruns. The continuing low performance showcased by many megaprojects demonstrates the way supervising expenses and schedule is not connected to time and cost performance, with Flyvbjerg (2014) confirming that 90% of mega-projects have cost overruns so the management of time and cost issues may be considered as 'fire fighting' to remain in operation (Maddaloni and Davis, 2017) and not necessarily to contribute towards reducing cost overruns in these projects. Musirikare and Kule (2016) studied construction projects in a section of Kigali, Rwanda and realised that even if project costs are proficiently scrutinized and other settings remain the same while construction continues, a significant rise in the costs is observed and in turn, if the estimated project cost is increased, accordingly a concurrent upsurge in the actual cost is noted implying that in many instances, the expenses in mega projects always rises. To thoroughly understand the factors leading to cost overruns, it would still be important to check the reasons provided by previous studies to see whether there has been any change in the reasons provided for cost overruns among the various mega projects. Various reasons have been provided by diverse scholars as to the cause for cost overruns in projects as described in the subsequent sections.

The study by Flyvbjerg et al. (2003) recognized and summarized the key reasons for megaproject cost overruns in infrastructure as incomplete risk assessment and poor decision making due to the absence of responsibility for the decisions. Lee (2008) analysed the reasons for cost escalations in the Korean mega projects and realized the critical reasons to project extent modification, unanticipated variations to the construction setting, illogical approximation and amendment of project expenses and no integration of the project to its value. Park and Papadopoulou (2012) found that the most significant causes for cost overruns of infrastructural projects in Asia as the bidding process where the bidder with the least costs was selected. Another reason provided in the study was the advance payment of contracts. Merrow (2011) highlighted seven reasons for cost overruns in projects as the unsatisfactory bidding process, inadequate risk assessment, unworkable cost approximations, lessening of the projected cost which affects quality, focus on time schedule along with an anticipated increase in net present value, heavy burden on the project manager and self-centeredness. In Brunes and Lind (2014) research that checked infrastructural projects cost overruns in Sweden using a questionnaire on experienced projects managers by examining two dimensions namely, once cost overrun happened and which section of the cost element was accountable, found that alteration in design, technical and operational issues leading to high amount of inputs indicating absence of proficiency, and optimism bias.

Adam, Josephson and Lindahl (2015) noted that surge in prices is among the known reason for cost overruns by states and academicians where approximately 20% to 25% of cost overruns is linked to an increase in prices and the other percentage can be connected to inappropriate design and inept execution, limited capital for the project, organizational vagueness, and absence of synchronization between processes and stakeholders. The view of price fluctuation is not agreed by all project managers as in a previous study by Brunes and Lind (2014) where the views of 101 project managers was checked, more than 30% were unsure whether price is a cause for cost overrun and nearly 50% had a contrasting view regarding the price increase issue.

Alhomidan (2015) undertook an assessment of contractors' perspective to examine the most common reasons for cost overruns in Saudi Arabia's infrastructure projects. The study adopted 41 reasons for cost overrun and the investigation showed in-house running bottlenecks, postponement of disbursements, communication breakdown among project affiliates and lack of timely decision making. Olaniran (2015) investigation found intricate relations among the project features, individuals, technology, organization and culture as the main problems triggering cost overruns in hydrocarbon megaprojects and chaos theory could expound on the reasons for cost overruns.

França and Haddad (2018) studied the causes of cost overruns in Brazilian construction projects from the contractors' standpoint of view using a questionnaire that examined the regularity of occurrence, severity, and significance. The study's sample were 11 directors, 17 project managers and 19 area managers from varied construction firms and the findings recognized features modification, incomplete design during making provisions, and increased indirect costs coupled with decreased output as the greatest notable causes for cost overruns.

Huo et al. (2018) scrutinised three independent descriptive variables namely type of project, magnitude of the project, and duration of the project execution in relation to cost overruns in Hong Kong infrastructural projects and the key conclusions were the approval year of the project is not linked to cost overrun, in regards to project type, railway projects had most cost overrun then fixed links projects and then lastly road projects. The study also showed cost overruns are not linked to project size but small projects in the road category had more cost overruns than bigger projects differing from many studies. Additionally, the study found cost increasing with the increase in deliberations of the projects.

Some academicians indicated project gain has an influence on project performance and by focussing on the wide network of stakeholders that is the public; it will assist to ensure accomplishment of the gains through decreasing preparation miscalculation and improving openness and culpability within the project's decision-making course (Maddaloni and Davis, 2017). Further, according to Pitsis et al. (2018), extensive coordination of all stakeholders is necessary for mega projects' success and sharing of experiences would equally limit the shortages in mega projects. To add, the scholars perceived that considering the lasting social and economic effects as an important ingredient to the arrangement and implementation of mega projects instead of perceiving the outcome as a burden would improve the project's performance.

Siemiatycki (2015) noted the upshots of cost overruns consist of a reduction in the national financial plan and the indication to the public that the state is not capable of attaining its pledges. Siemiatycki (2015) summarized the worldwide renowned actions to reduce or eliminate cost overruns into five solutions for this issue. Firstly, the availability of wide data manipulation techniques can be used to aid in productivity checking, evaluation, and distribution of vital information. Secondly, respective states could watch over and compensate the most complaint organization and service providers to encourage better performance and also provide a foundation for warranting expected results. Thirdly, by training employees who are supervising mega projects in managerial abilities such as the implementation of tenders and resolution to disagreements. Fourthly, by using past experience data, states could look into identifying the best predicting model. Lastly, the states could motivate public-private partnerships so as to easily adopt cost control and time limit measures.

Some scholars have consolidated the causes of cost overruns as described below. In Cantarelli, Flyvbjerg, Molin, and van Wee (2013) study examining the causes of cost overruns in construction projects through an exploration of previous literature led to the grouping of the causes for cost overruns to four key reasons that are technical, economic, psychological and political. Using Flyvbjerg studies (Flyvbjerg 2006; Flyvbjerg and Molloy 2011; Flyvbjerg et al., 2016), the causes of costs overrun are summarized as technical, psychological, intentional underrating of costs by contractors and politicians, and incomplete sponsoring of projects and ineffective management of contracts. Love et al. (2016) and Ahiaga-Dagbui and Smith (2014) describe the reasons for cost overruns in two perspectives, first, the scholars agree with the evolution theory which explains the consistent evolving nature of projects necessitated by project extent changes and secondly, the scholars attributed cost overruns to the psychological effect an organizational setting. Although in Love et al. (2012) the scholars underscored the importance of optimism bias and strategic misrepresentation, in a current study, Love et al. (2016) further proclaims that optimism bias and strategic misrepresentations on their own are not sufficient to completely clarify the reason for cost overruns and suggested a more all-inclusive method which integrates the project's procedures and its technicality.

From the consolidated views, it is evident that cost overruns are linked to cognitive biases of the project stakeholders due to the causes stated as optimism bias, strategic misrepresentation, and political. Love et al. (2016) study noted that the trend to investigate discreet grounds of cost escalations in mega projects and the neglect of scrutinizing the interrelations between the sources of cost overruns does not provide sufficient evidence and as such this study identified decision making as the main mediator between cognitive biases and cost overrun so as to cover for the project's complexity and other technical causes since decision making is very important to the success of company activities (Sage Publications, 2019) and in mega projects, decision making is considered as the missing link vital for successful project execution (Rumeser and Emsley, 2018). Further, decision making is impacted by similar factors to the problem in this study which is cost overruns. As noted in Steen et al. (2017) study, political, organizational, and psychological elements influence decision making in mega projects and the technical aspect of organizational issues is represented by the socio-technical elements which are magnified by the projects size and participation of numerous stakeholders and expertise.

Complexity, wide scope, extended duration, huge funds, and longitudinal surrounding settings prompt increased risks to mega projects than other projects which heighten the rate of cost overruns (Andrić et al., 2019). Decision making on complex situations is a critical topic in managing projects (Rumeser and Emsley, 2018) and according to Flyvbjerg (2014), decision making is the main determinant of success in complicated projects. Attri and Grover (2014) indicated that the current decisions made on projects are connected to the complexity and bias of the decision makers. More, all practices revolving around managing projects necessitate decision making such as in choosing projects, hiring project managers, assessing bidding documents and choosing suppliers or contractors among other similar activities (Rumeser and Emsley, 2018).

Naturally, megaprojects are strategic and thus decision making is also strategic. According to Calabretta et al. (2016), strategic decision making is optimized through a combination of analytical and intuitive decision making. Musirikare and Kule (2016) proposed strictly checking costs as a way to lessen the project cost overruns hence analytical decision making can be applied to manage the cost overruns and associated risks while intuitive decision making can be used to handle the complexity surrounding deviating and contradictory intentions arising from the huge number of stakeholders, that is, the community, government, and private investors which initiate conflicts (Wu, Zhao and Zuo, 2018). Oliveira (2007) exclaimed that the primary elements of decision making are decision and behaviour as decision making entails the way people think and respond to the environment including reflecting on the past occurrences and predicting the upcoming happenings. Decision making also includes the mental effect of decision maker on the decision made (Oliveira, 2007). Research has affirmed that decision makers depend on some choice guidelines called heuristics to simplify complicated settings, even though these rules are essential and valuable, they can prompt cognitive biases that initiate extended and organized miscalculations in decision making (Cunha et al., 2014) leading to the final research question, what is the connection between cognitive biases, decision making and cost overruns.

### *1.3 Research Gaps in Knowledge*

From the problem statement above, the researcher seeks to examine different authors in the field of mega projects from the perspective of bias in order to point out specific gaps existing in knowledge, which supports the need for the current study. Firstly, a study by Mohamed, Emes and Leal (2018) opined that infrastructural projects are to a larger extent affected by biases and heuristics in decision making. Similar assertions are shared by a publication made by a Behavioural Insights Team (BIT) of 2017 which maintained that individuals' behaviours have a potential impact on decisions made in projects, industry notwithstanding. Nonetheless, the two publications make an overwhelming recommendation that it is important for awareness creation in ensuring that decisions made are in line with overall project management goals, a fact that has not been given much attention in the modern studies (Mohamed et al., 2018; BIT, 2017). While focusing on life in general, Stillman (2016) gives a different view of cognitive biases by stating that there are six main factors that influence human mind's decision making process and these are; fallacy of sunk cost, halo effect, anchoring, availability heuristic, survivorship bias, and confirmation bias respectively. However, although Stillman (2016) makes a credible contribution to the knowledge of cognitive biases, the publication fails to demonstrate a link between the identified factors to project management context.

More importantly, a publication by Gloria, Power and Mora (2019) states that the process of decision making is generally affected by certain risk attitudes that individuals embrace, which are often not used in the proper manner in which they were intended such as use of communication technologies and data analytic techniques. Ideally, this view demonstrates that there is a wide gap in terms of how technology has been developed to aid project management in decision making and how it is actually being practiced. Additionally, it is demonstrated that cognitive biases have been linked to health care decisions as opposed to other areas as opined by Burke, Leonard, Marcie, Ayele, Ethan, Rebecca and Greysen (2019). As a matter of fact, it is clearly demonstrated that areas which are thought to be sensitive such as medicine and nursing are given much attention than other project areas such as in infrastructure and technology. Moreover, a systematic review by Gustavo, Donald, Ruff and Tobler (2016) confirms this assertion and indicate that medical decisions are usually well thought off, but sometimes the perceptions of the practitioners might lead to wrong prescription and analyses, which perhaps could be different if decisions are made from different perspectives.

Similarly, Chloe and Samia (2017) asserted that there is often implicit bias among medical professionals that can lead to different diagnosis examinations on the same individual if different practitioners are independently involved. This is a confirmation that decision making largely depends on an individual's cognitive biases, and this can have a huge impact on the projects being initiated. Equally, a publication by Mannion and Carl (2014) suggested that group decision making have systematic biases which are different from individual decision making instances. Further, a study by Jennifer and Jessica (2017) also indicated that personal traits and circumstances such as poverty has got a great effect on decision making, which can be linked to a cognitive bias of a person. In support of this claim, a study by Kate, Lucy, Susanne and Gonzales (2017) maintained that organisations must eb able to understand different personalities and ambitions of their members in order to ensure that decision making processes are fair, to warranty sustainable project management practices. However, none of these reviewed studies have demonstrated a special attention towards mega projects, irrespective of the industry, hence, an indication that there exists a wide gap in knowledge that should be filled by this study.

*1.4 Research Aims and Objectives*

*1.4.1 General Aim*

The general aim of the study was to investigate the influence of cognitive bias on decision making in mega projects, taking to consideration its impact on the cost overruns which is identified to be the main problem associated to different decision making contexts.

*1.4.2 Specific Objectives*

In order to achieve the above general aim, the following specific objectives have been formulated to serve as road maps in achieving the desired outcomes to;

(i) Ascertain whether cognitive biases can be linked to causes of optimism and its impact in project decision making and performance.

(ii) Determine whether cognitive biases can be linked to project manager demographic characteristics and its impact on project decision making and performance.

(iii) Investigate the personality traits of project managers that can be associated with cognitive bias and how this impact project decision making and performance.

(iv) Propose recommendations that can be adopted by project managers when executing mega projects.

*1.5 Research Questions*

From the above aim and objectives, the following questions are formulated to guide the research inquiry and the empirical analysis and to find inter-relationship of cognitive bias on daily decision making in mega projects.

RQ1: What are the cognitive biases in decision making that can lead to cost overrun in mega projects?

RQ2: What are the key project manager demographic characteristics that impact mega project decision making and performance?

RQ3: What are the personality traits of project managers that can be associated with cognitive bias, decision making and performance?

### *1.6 Research Scope*

The on-going research is grounded in mega projects, thus, ultimately the goal is to highlight how the identified cognitive biases influence decision making of project managers. The key participants of interest in the investigation are project managers, thus all evaluations in the study are done in consideration of how project managers' decisions are impacted by cognitive biases. While studying cognitive biases and decision making other associated topics such as personality traits are explored. Specifically, the personality traits of project managers are included in the study as there is evidence that they play a role in decision-making. Further, the study examines the environment in which project managers make decisions, the challenges they face and how cognitive biases play a role. In detail, the current study, examines cost overruns and how they model decision making by project managers. Further, the study explores decision making in the risky environment in which Mega projects are incepted. The most potent factors known to influence decision making of project managers such as personality traits, cognitive bias and demographic characteristics are explored in-depth. The study does not aim to explore the interplay between the above-mentioned constructs; instead, the discussion is limited to elaborating how cognitive biases influence decision making in mega projects. Therefore, the sample under study is made of individuals with adequate knowledge on project management. Different theoretical conceptualizations of decision-making processes are also included to contextualize cognitive biases with existing research.

### *1.7 Significance of the research*

Quite a number of studies have shown the eminence of cognitive biases in decision making however there is limited research relating cognitive biases to cost overrun in the context of UAE mega projects. Al-Ali, Emes and Leal. (2018) studied the views of 50 participants whom included project managers, projects engineers, executive directors,  and systems engineers to examine the level of awareness of decision making heuristics and biases in the choosing of infrastructural projects and found that more than 85% of the respondents were not acquainted with the knowledge of heuristics and biases in decision making indicating very low rate of awareness especially for the sample checked where over 70% were decision makers in various projects. The dismal rate of awareness with regards to decision making heuristics and biases could inhibit the way decisions are made and since open acknowledgment and intended elimination of unwanted heuristics and biases enhances the managing of projects Al-Ali et al. (2018), this research expounds on the significance of heightening the awareness of the mental traps to assist in evading the cognitive downfalls (Chatzipanos and Giotis 2014).

### *1.8 Purpose of the Research*

The research aims to examine how cognitive biases influence decision making in mega projects. In line with the above overall goal, the study has a specific purpose. Firstly, the study aims to highlight the fact that the increasing size and scope of mega projects is impacted by cognitive biases leading to faulty decision making. Further, the purpose of the study is not only to explain how cognitive biases influence decision-making but also to solidify cognitive biases as among the critical reasons why mega projects end up in cost overrun. Therefore, traditional factors leading to failure of mega projects are also discussed, however, the purpose is to bring to light the effect of cognitive biases on daily decision making that scholars and stakeholders may ignore as they are subtle. Moreover, the study purposes to awaken interest in scholars studying mega projects especially because the influence of cognitive biases on daily decision making is often ignored and most project managers are unaware of such biases. In the end, being aware of cognitive biases is adequately helps to avoid falling prey to the phenomenon especially in mega projects where miscalculations can be costly and detrimental to entire economies.

*1.9 Structure of the Project*

The current research study explores the influence of cognitive bias on decision making in mega projects in eight chapters. The first chapter above elaborated the background of the study detailing information which is crucial to comprehend prior to delving in the research. Further, the first chapter above acts as a guide for the rest of the paper as the problem under study is elaborated in detail, the scope of the investigation and the research questions the study aims to answer. The second chapter explores the characteristics of Mega projects. In detail, the second chapter explores the set up and execution of mega projects. Apart from clarifying what passes as mega project, the chapter also explores how they are executed, the challenges faced during implementation and decision making in mega projects. The second chapter is meant to provide in-depth understanding as far as mega projects are concerned. The third chapter explores cognitive biases and decision-making. The first part of the chapter focuses on cognitive biases exploring each bias individually. The second part of the third chapter focuses on decision making theories detailing the existing frameworks in research as far as decision-making in human beings is concerned. The decision to combine cognitive biases and decision-making theories in one chapter is inspired by the close relationship assumed in the on-going investigation. The fourth chapter is the conceptual framework under which the study is constructed. The relationships between the constructs under investigation are explored and justified to allow the creation of a correct model that can be tested statistically and yield meaningful results. The conceptual framework also guides the methodology found in the fifth chapter. The methodology explains and justifies in detail the research design, the participants, sampling methods, data analysis techniques and research methods used. Further, research philosophy adopted for this investigation is presented to align the study to the broader realm of research.

## Chapter Two: Mega Project Context and Specific Characteristics

### *2.1 Introduction*

Megaprojects differ significantly from typical development programs in a number of ways. In fact, a synthesis of the literature on Megaprojects in research indicates that they have been investigated independently of other programs due to their unique characteristics. Flyvbjerg (2017) defined Megaprojects in the context of the financial load; time taken to undertake the projects, and the transformational impact of the projects (p.2). In essence, Frvybjerg (2017) notes that Megaprojects are typically aimed at value generation that will benefit millions of lives. Notably, megaprojects have been defined in other contexts, for instance, they have been described as endeavours characterized by unmatched complexity, extensive uncertainty and long periods of execution that transform the landscape of whole regions or nations (Zhai, Xin, and Cheng 2009). Lastly, megaprojects have also been defined from a sociological point of view, where the ambitions of human beings and their plans for the future are seen to influence the characteristics of mega projects. Specifically, Gellert and Lynch (2003) noted that mega projects often required the participation of both private and public stakeholders to successfully complete. This chapter details the characteristics of Megaprojects from a research point of view. The aim is to collect important facts about mega projects to suffice the discussion on how cognitive bias influences decision making. Further, the chapter also highlights the stages involved in the execution of mega projects, the challenges encountered and how they are related to cognitive bias.

### *2.2 Mega Projects and Decision-making*

Megaprojects can be seen as the absolute generally intriguing wonders in sociology. They speak to the real accomplishments by assemblages to impact the advancement and course of society and the assembling of aggregate solidarity to imbue major institutional change. In the past few decades, megaprojects have been interrelated with state prestige, radical economic progress and supposed public and infrastructural development (Halder 2018). Van Marrewijk (2017) expresses that mega projects are looked upon as contemporary indicators for noble standing, advancement, and political supremacy (Van Marrewijk 2017). Many countries use megaprojects as a way of nation-wide upgrading, but it is critical to note the liability necessitated by a wide variety of risks that are associated with megaprojects (Halder 2018) They are significant, along these lines understanding their temperament also, elements are absolutely a significant assignment for sociology. Understanding the method of reasoning behind the choice to execute a mega project will lead us to look further into what appears to drive the megaproject business and why megaprojects are viewed as alluring to stakeholders who are driving these endeavours forward. Flyvbjerg (2014) presented the structure of the four sublimes of megaprojects from which he clarified the variables that drive megaproject advancement and that assume a huge job in megaproject basic leadership. He recognized the mechanical, political, financial, and stylish sublimes as the most significant ones to clarify the quick extension of the matter of the megaproject. Surely, propelling a megaproject is a way of getting consideration, a method for completing things—of making dreams and high desires. Researchers take part in different huge scale ventures, filling in as post-doctorates also, later on as executives of research in structure the worldwide learning of material science and science. The undertakings work as "activity areas" (Grabher, 2004) that enact inert ties, assemble new ties for cooperation and learning and build up future ties moulding the bearing of modern and innovative improvements.

Although mega projects have been seen to yield astonishing results and benefits to the whole world in their respective environments, a lot of research shows that the performance of projects is extremely below par especially in relation to overruns in expenses (Gbahabo and Ajuwon, 2017).  Additionally, megaprojects are known to result in disappointing outcomes for stakeholders, the environment and the target population (Merrow, 2011). A synthesis of research by Garemo, et al. (2015) attributed the failure in Megaprojects to three basic reasons. Firstly, extreme complexity coupled with over-optimism has been identified as a leading cause (Garemo, et al., 2015). When projects managers are looking for financial support and investment for mega projects, there is a tendency to underestimate the costs of the project while simultaneously over-estimating future benefits. In the end, the project managers with the most cost-effective strategies win funding, thus, leading to unexpected outcomes when the actual project is executed. The tendency to underestimate costs while overestimating future benefits of projects is a common cognitive bias and Garemo, et al. (2015) claimed that project managers often manipulate data analytically to yield attractive values that are deemed affordable to financers and other potential stakeholders. The underestimation of costs and extreme over-optimism are detrimental to mega projects in the long run, however, Garemo, et al. (2015) notes that without such measures there would be little support for pursuing mega projects. Further, over-complexity resulting from the innate characteristics of mega projects is also known to impact the success of mega projects negatively.

The second factor contributing to unsuccessful mega projects is related to poor execution of the projects. Garemo, et al. (2015) claimed that challenges arising from the aforementioned underestimation of cost lead to poor execution resulting from unfinished designs and attempts to take short cuts that ultimately lead to failure. The final reason is connected to the actual structure of the organizations involved in the execution of mega projects. While poor execution is connected to low productivity due to budget constraints, weaknesses in the organizations and firms involved in mega projects also contribute to failure. Garemo, et al. (2015) argued that project managers are often placed at more than three levels below the leadership chain. Notably, the different levels of the organizational structure have different ambitions and perceptions of cost and expenditure thus, making it difficult for project managers to deliver. Further, Garemo, et al. (2015) notes that top levels in the leadership chain may have goals that are not aligned to those of project managers, thus, impacting the ability to effectively deliver on mega projects. For instance, contractors and subcontractors may be more interested in profits while projects managers focus on delivering on time and within cost constraints. Despite the immense focus in the literature on cost overruns, there has been no noteworthy improvement to ensure the dependability of the projected cost approximation and real cost (Ahiaga-Dagbui, Smith, Love and Ackermann, 2015). Even though this research is focused on the interplay between cognitive bias and decision-making, it is crucial to take note of the other variables that hinder the ability of project managers to deliver successful Megaprojects. Notably, other environmental variables have an influence on the success of a Megaproject.

Even though mega projects are rife with inconsistencies that lead to failure and disappointment to stakeholders, investors, local populations and the environment, their prevalence is increasing. In fact, more ambitious projects with extreme budgets are coming up. The above phenomenon has been coined the “mega project paradox”. Currently, megaprojects are increasing in number and scale to meet the economic needs of human beings. Moreover, the challenges commonly associated with mega-projects do not seem to deter investors and stakeholders from participating; this is because of the role mega project play in society and human progress. Specifically, mega projects attract a lot of attention due to their uniqueness and magnitude thus; they are used for political mileage. In the end, the political impact of a project may overshadow the benefits of the projects when costs and its impact on the environment and economy of a nation are considered. One explanation behind such increasing scale and magnitude in megaprojects can be gathered from the forecasts of the infrastructure required to meet the globe's ever-growing need for financial and economic development and enhancement. An illustration of the above-described phenomenon was given by Garemo, Matzinger and Palter (2015) who projected that the world needs to spend about US$57 trillion on infrastructure by 2030 to remain at par with the normal Gross Domestic Product development. Further, OECD a key organization in projecting the world economic activities projected that the globe needs at least $6.3 trillion to meet global growth and development needs for the next 14 years to 2013. In addition, megaprojects are relied upon to expand quickly to 24% of the worldwide GDP in the coming decade (Frey,). Further, it is predicted that the ventures are meant to control hazardous climatic events, handle and manage a lot of information in the data age, and tackle human issues, such as illnesses and deadly diseases. In that regard, there is by all accounts a general agreement among many driving examiners that megaprojects are definitely not just on the ascent, they are likewise expanding in size and assortment.

### *2.3 Role of Decisions Made in Mega Projects*

In running and managing mega projects, it is important for project managers to appreciate the fact that the context in which such decisions are made is absolutely different from other scenarios, particularly for small and medium projects as opined by

Yang (2014). However, this assertion is disputed by Harvard Business Review (2016) which holds that all decisions in project management are simply made in a similar manner, since there are four basic types of project phases that are apparent in any project and these phases include; planning on project deliverables, building up the project in accordance with the identified deliverables and parameters, implementation of the designed plans, and finally the closure. The Harvard Business Review (2016) maintains that these phases are applicable to all projects irrespective of the industry in question or even the size of the project (whether small or large). It is interesting then to critically review the assertions by the Harvard Business Review (2016) on the relevance of the project phases in decision making, to mega projects in specific. Nonetheless, the publication further adds that there are other phases which can be integrated in the four broad types, and such phases include although they are not limited to; problem identification, stakeholder mapping, and scope determination among others (Harvard Business Review, 2016) as will be debunked in subsequent discussions.

In a publication by Locatelli, Mariani, Sainati and Greco (2016), it is opined that corruption has been the main impediment for project success especially when decisions are being made at different stages of projects. While focusing on planning of project deliverables as the first phase as opined by Harvard Business Review (2016), Locatelli et al. (2016) maintained that corruption can potentially make it difficult for project managers to effectively execute all the required deliverables at different phases, particularly in the case of mega projects. However, although Harvard Business Review (2016) agree with Locatelli et al. (2016) on the impact in the mega projects, the two publications have divergent opinion when it comes to small projects, in which case the former publication maintains that the impact is the same across all types of projects, while the latter authors maintaining that this is only applicable to large projects only. Agreeing with assertions made by Locatelli et al. (2016), Hugo (2008) had hinted that decision making on mega projects is absolutely different from small projects' context.

Further, a publication by Khan, Waris, Ismail, Sajid, Ullah and Usman (2019) maintained that any potential deficiencies in project management decision making brought about by a number of factors such as leadership approaches and corruption will have a huge impact in mega projects as opposed to small projects. Precisely, Khan et al. (2019) agrees with Harvard Business Review (2016) on matters to do with project planning, which encompasses the efforts of determining the particular problem that is needed to be solved by a proposed project. For instance, Walton (2013) suggested that during problem identification, corruption can divert the attention, by having project leaders and managers whose interests are not in agreement with the overall goal of project stakeholders such as the anticipated beneficiaries as well as the donors or project partners. Fundamentally, in such situations, the overall impact is that problems which are identified are not congruent with the problems which are really faced in the society as maintained by Walton (2013).

In another systematic review, Nguyen et al. (2018) elucidated that entities running mega projects often suffer from a major setback of project planning due to poor mapping of project stakeholders, including their interests and objectives. Once such a situation is evident in a mega project, Halder (2018) opines that it leads to wrong prescription of the project's existence, which means that it will definitely not achieve desired outcomes. As a matter of fact, it is argued that it is not possible to achieve goals which are not clearly identified from the onset, during the planning phase of a project (Williams, Ferdinand and Pasian, 2015). In the most recent study, Andric' et al. (2019)

maintained that project managers should have a clear mind set when it comes to mega projects, because losses attached to them are usually huge by virtue that there are huge investments committed to such projects. However, Andric' et al. (2019) seem to be in agreement with Harvard Business Review (2016) that although the magnitude of loss and inconvenience can be different, the fact remains that poor planning and decision making will lead to negative impacts on projects' success, industry and size notwithstanding.

While exploring the issues facing projects' decision making processes, a study by Williams (2010) noted that it is possible for project managers to clearly identify the project sponsors and other partners or stakeholders' goals, but then end up with a wrong definition of project objectives. This is particularly possible when the experience of the project managers is not sufficient, followed by the tendency of opposing change by management team (Siemiatycki, 2015). Although there is no empirical evidence outlining that the more experienced a project expert is the more clearly the project objectives are defined, it is assumed by Vahidi (2013) that the reality on project management is that the involved management team should start from identifying the overall scope of the project, the needed resources, and any potential major tasks that will need management monitoring in order to achieve success. Moreover, this will help objective establishment and preparation of trade-offs, in which case the main concern is on three fundamental variables for project achievement which are cost, quality and time respectively (Harvard Business Review, 2016). According to Sarmento and Renneborg (2016), such aspects of planning are important in mega projects, and as they are emphasised in Harvard Business Review (2016), they include although they are not limited to; problem identification, stakeholder identification, objectives definition, determination of scope, tasks and resources, and trade-offs preparation respectively. In other words, Pitsis et al. (2018) suggests that if any of the above factors is not appropriately approached by management, then decision making process will be inadequate and this can play a major role in determining the success or failure of mega projects.

Another important role of decision making in projects as opined by Zidane, Hussein, Johansen and Andersen (2016) is enhancing efficiency at operational, tactical and strategic build-up processes with an aim of having the projects rolling and planned activities being executed. This is fundamentally important is it facilitates the integration of different interests of stakeholders, towards a harmonized aim of the project that is to be achieved. For instance, according to Jergeas (2008), the first important decision at this point is to assemble the project's team, by considering the specific traits and qualifications that can enhance productive execution and achievement of project goals. This is the point, at which teams are evaluated based on their experiences, uniqueness, abilities, and the overall motivation to spearhead the process in helping the involved organisation and parties to achieve better performance results of the projects (Zekovic' et al., 2018). In this claim, Harvard Business Review (2016) agree with Jergeas (2008) as well as Zekovic' et al. (2018) on the fact that identifying the qualities of team members makes it possible to determine the tasks and assignments that will be performed by each parties, hence utilising their individual strengths and also managing their weaknesses to enhance success and eliminate failure respectively. In this regard, the role that is played by decision making at this point is extremely important as it determines whether the project will eventually succeed or not (Gbahabo and Ajuwon, 2017).

Whether teams are assembled and assignments planned, success in managing mega projects will be an upheaval task if there are no elaborate strategies to create adoptable schedules that can be adhered to by team members. However, care must be taken in ensuring that there is full involvement of related parties or stakeholders such as employees and users of project outputs in creating schedules (McKenna and Metcalfe, 2013). According to Harvard Business Review (2016), creation of schedules is a very important role played in a mega project decision making process in determining the success, which is a potential preclude for holding a kick-off meeting with all those involved in planning and implementation of the project. Further, Yang (2014) stated that this is particularly important in allowing the project teams to read from the same script as to what the overall goals and deliverable outputs for a project are. In this regard, a kick-off meeting is of greater importance in giving the decision making process an opportunity to provide a clear framework of the project, the expected milestones, and the time schedules that will be followed strictly. According to Martinez (2016), such a meeting leads to proposals on project's budget, which is then validated through consultations and discussions with the relevant partners and donors. Ideally, these specific strategies mark the build-up phase which entails; team assembling, assignments planning, schedule creation, kick off meeting, and budget development respectively. Further, the strategies are important to the extent that if they are not followed, then mega objects are bound to fail and lead to huge project losses.

While focusing on the decisions made during the implementation phase, it is argued by Harvard Business Review (2016) that it is important to reflect on how a project can be executed, so as to have a clear road map that should be followed by all the involved parties. The first approach as proposed by Caniato, Vaccari and

Visvanathan and Zurbrugg (2014) (2014) is to put in place mechanisms that will promote control and monitoring process for the developed budget. Thus, project managers appreciate the fact that the monies involved for mega projects is usually huge, and this demands proper accounting and management, for success to be achieved. Further, Caniato et al. (2014) maintained that effective decisions involves production of reports, which are discussed by relevant parties to determine if there are variances, and hence come up with ideal strategies to correct such variances and ensure that project direction is redefined for the team members. In order to make sure that this decisions are constantly made and achieved, it is important for the management and project teams to have regular review meetings, for instance on a weekly basis, so as to provide a favourable environment of investigating and identifying variances earlier enough so that mitigation measures can be instituted when it is not too late to salvage the projects if mistakes have been committed. Additionally, another important role played by decision making in mega projects is the appreciation that huge projects are complex in terms of management, and the potential eruption of conflicts and problems is inevitable. Precisely, this view makes it possible for project managers to identify instances where problems have raised early enough to provide more time in managing such problems before it is too late, to avoid huge frustrations and failures (Ommen, Blut, Backhaus and Woisetschlage, 2016).

According to Afreen and Kumar (2016), decision making is paramount not only in planning and implementation, but also in the project closure. For instance, it is argued that it is important to evaluate the overall performance of a project, based on a number of indicators predetermined during the planning stage. These assertions are shared by Mok, Shen and Yang (2015), who also support the fact that project closure needs critical decisions that are often characterised by nature of reports that can be produced towards the end of the project lifecycle. Similarly, Harvard Business Review (2016) opines that after the project has been closed, it is important to debrief the team members, so that they can understand how their efforts impacted the project's goals and vision. Moreover, Floricel, Michel and Piperca (2016) also indicates that the decision of debriefing team members serves a motivational function as a communication tool, which also helps in future team spirit as it is viewed by employees as a means of providing instrumental feedback. This is also echoed by Debrie and Raimbault (2016) who argued that project closure is as important as project determining, and therefore such decisions are important in mega projects.

As a matter of fact, it is clearly demonstrated that project decisions at different stages in the life cycle of mega projects is of extremely relevant significance, towards its success. Nguyen et al. (2018) emphasise that decisions can be as a result of the project characteristics, while Aaltonen et al. (2015) refutes this claims and indicate that it usually depends on the nature of leadership styles adopted by project managers. Nonetheless, a study by Chatzipanos and Giotis (2014) maintained that both project leadership and characteristics are important determinants of how decisions are made in projects, hence supporting claims by Nguyen et al. (20180) and Aaltonen et al. (2015) instead of showing them as conflicting assertions. In another view, Ali-Ali et al. (2018) demonstrated that what is of great importance to be considered is the characteristic of a project in terms of its value and magnitude, hence implying that its size (whether small or mega), is what is of critical relevance. In spite of the different arguments by different authors, what is is seemingly agreed upon and clear is that mega projects' decision making process are absolutely different from small projects. Thus, decision making plays an integral role in the overall performance or failure of a project. This establishment leads to further critical inquiry of the mega projects that have been discussed in the background section that failed to achieve their objectives such as timely completion and within budgets, as they were found to have significant cost overruns. As a matter of fact, applying the literature in this section to such projects, it is an indication that there were instances of poor decisions within the life cycle of projects, which in return affected project performance in the long run.

Apart from the context of mega projects' decision making given in the previous sections, other scholars hold a contrary opinion in which they demonstrate an inverse relationship between project decisions and project methodology adopted. For example, a study by Amir and Azad (2015) opines that the types of project methodologies used in an organisation have a significant impact on the nature of decisions that will be made in that organisation. However, the studies further note that the decision to acquire certain methodologies over others is what is important and this determined the subsequent role that choices will have on project performance (Amir and Azad, 2015). Supporting these assertions, Suda, Rani, Hamzah and Chen (2015) also indicate that decision making in the context of project management is influenced by the theories used as the key philosophies in managing projects. However, the two studies have not made any effort to distinguish between mega projects and small projects, and how these different contexts can differ from one another. While appreciating that decisions in managing projects have to be well-thought off, they speed at which such processes are done and decisions reached also determines the role that will be played in projects' success, particularly when it comes to large projects (Wen, Gloor and Qiang, 2018).

Rondinelli (2016) further acknowledges that projects fail especially in developing nations due to poor choice of methodologies or lack of proper methodologies to use. In this regard, the choices are shown to be perhaps a limitation by virtue that there are no alternatives in such markets or a general omission by management. Further, a study that focused on health projects indicated that the type of methodologies used determine the efficiency of project assessment, in which case some methodologies are superior to others in promoting effective management and leadership (Craig, 2019). However, the study by Craig (2019) did not put emphasis on mega projects but rather focused on health projects without distinguishing small and large projects. These assertions by Craig (2019) and Rondinelli (2016) are affirmed by Nyumba, Kerrie, Christina and Nibedita (2018) who maintained that project management insights and success are dependent on how data is obtained and analysed in order to inform subsequent decisions.

Closely associated to project methodologies are the nature of information technology and systems used in managing and monitoring projects. Specifically, a study by Yaser, Alina and Aziati (2013) observed that managerial decisions in project management highly depend on the nature of information systems in an organisation. In support of this claim, a study by Too and Weaver (2014) found out that ICT is becoming an important tool in aiding relevant decision making processes for project management globally. Ideally, it is emphasised by Karim (2011) that use of information systems cannot be underestimated in the modern management of projects, as this is a very essential platform that determines how decisions are made, and if the decisions are ideal in promoting overall success of projects or not. In addition, Cristobal, Carral, Diaz, Fraguela and Iglesias (2018) indicated that as the projects becomes more complex in nature and size, the need for use of information systems becomes inevitable, failure to which the decisions made are not optimal. In this regard, project decision making processes are influenced greatly by different circumstances surrounding particular projects, and this has got a huge role in the overall performance of mega projects.

### *2.4 Measuring Performance of Mega Projects*

Different authors have different views on how performance of projects can be measured, so as to determine if they are successful or not. However, a study by Baraza (2017) indicated that project performance is often measured based on a number of parameters such as completion time, cost of completion, quality, and the level of client satisfaction. Nevertheless, Baraza emphasized the fact that performance of projects must also examine the needs of the projects and whether those aims were met or not, particularly for mega projects. According to the views shared by He, Lan, Hu and Chan (2014), project performance must take into consideration the impacts such projects have to the society, in the spirit of social responsibility requirements. Further, Leong, Zakuan, Zameri, Shoki and Tan (2014) maintained that quality management effectiveness is the ideal way of measuring project performance, although it can generally be difficult to measure in absolute terms. Disputing assertions by the above authors, Soewin and Chinda (2018) opined that performance of projects depends on the industry in which a project is implemented. For instance, they opined that a construction in the housing industry can be completed within the time frames, within the proposed financial budgets, of good quality during completion based on outlook that eventually satisfies the clients, but unfortunately collapses especially during adverse weather conditions and this can be concluded that it was not a successful project. Therefore, according to Soewin and Chinda (2018), project success goes beyond the completion metrics, to include its usage and permanency. Nonetheless, these studies did not distinguish between mega projects and small projects in terms of their performance.

However, from the background information, there is an overall tendency of mega projects being measured from the cost overrun perspective. In this case, it is opined that once projects overruns exceed the planned budgets, then such projects can generally be said to have not performed as expected. As a matter of fact, there are a number of factors that can lead to cost overruns, which ranges from poor decision making to poor implementation of strategies (Nguyen et al., 2018) Essentially, in a critical assessment of empirical evidence, a research gap emanates on the concept of measuring performance based on cost overrun, with regard to the economic conditions, political environment and social set-ups in different regions. For instance, literature shows that mega projects' overruns is not the same in different parts of the world such as Asia, North America and other places respectively. This leads to the need to undertake future inquiries targeting to demonstrate whether cognitive biases do differ from one place to another based on different environmental circumstances, in addition to an establishment as to why this is possible. For example, it has been noted in the literature that corruption is likely to hinder making of effective decisions that can as a result lead to poor project implementation as opined by Locatelli et al. (2016). Therefore, the main questions are whether the regions which are highly corrupt have cases of project cost overruns being more than those with less cases of corruption or not. More importantly, literature has shown that cognitive bias plays a major role in project planning, implementation and control, which is directly related to the level of performance of projects. In this regard, while seeking to measure performance of mega projects from the cognitive biases perspective, areas that cannot be overlooked include but they are not limited to; personality traits, demographic characteristics, cost overruns and how they impact client satisfaction and overall aims of the projects from a decision making point.

*2.5 Challenges of Mega Projects*

In what capacity can organizations and governments improve to construct mega projects that convey their societal advantages and do as such on schedule and on a strict spending plan? To address that question, the current investigation considers the most significant reasons that megaprojects vacillate, and after that, the study proposes standards for development based on the challenges identified. Megaprojects are regularly overcommitted and focused on a particular sort of venture idea at a beginning period; this limits the number of alternatives that can be implemented. In the end, investors and the founding stakeholders may select weak ideas based on limited projections simply because the ideas were preconceived at an earlier date. This eventually leads to failure if proper management is not followed through. Megaprojects are characteristically hazardous as a result of long-range execution horizon, nested requirements and specifications, and unpredictability. Flyvbjerg (2007) and van Wee (2007) contend that poor results happen in the conventional megaproject ventures because of improper allotment of risk among the stakeholders involved. Zhang and Kumaraswamy (2001) state that megaprojects especially those related to infrastructure fell short of meeting unique partner desires, subsequently, they advocate for Public-Private Partnerships (PPPs) that give cooperative energy to both private and public sectors. Further, Flyvbjerg et al. (2003) affirm that megaprojects over the globe dependably experience a cataclysmic history of cost overwhelms. According to Haidar and Ellis (2010), such tendencies are a result of expansion in size and complexities among in megaprojects forcing huge venture the board challenges. Moreover, Haidar and Ellis (2010) contend that conventional administration practices are deficient to oversee megaproject conveyance. Time overruns are also an additional challenge associated with megaprojects. At times projects are began and take extremely long to complete. For instance, a metro system in Salvador took more than a decade to be commissioned for use. In the same light, megaprojects may be planned but not executed for a long duration of time. In extreme cases, such delays before a project is undertaken may take up to a decade. For instance, the rebuilding of the $3.9 billion Tappan Zee Bridge in New York. A typical case of this comes when enormous activities cross state or national outskirts and include a blend of private and government spending. For instance, another railroad could include three national governments, various nearby governments, distinctive ecological and wellbeing gauges, differed degrees of abilities and pay desires, and many private contractual workers, providers, and end clients. Only one issue can slow down the procedure inconclusively. In one case, for instance, it took two nations more than 10 years to work out the strategic contemplations that enabled them to construct a hydroelectric dam. Very frequently, these confounding issues are not profoundly considered or estimated to the fullest before propelling a venture. It regularly takes a very long while from the planning phase to the actual completion of a mega project. Further, Megaprojects are based on deception about expenses, time horizons, merits, and dangers. The outcome is a cost overrun, postponements, and advantage shortages that undermine mega project suitability during task conveyance and activities (Flyvbjerg, 2017). This issue will in general lead to difficulties for execution as challenges ought to be addressed while the project has already begun instead of prior planning. In addition, the absence of authenticity and realism in introductory cost gauges, underestimation of the length and cost of the postponements, changes in details and plans, under measured currency exchange taxes,,low possibilities of success, failure to take into account risk arising from topographical nature of a region, underestimated amount and value changes, risk arising from fast technological development and understated confiscation costs. Other challenges of megaprojects are associated with, underestimation of size and multifaceted nature, non-reasonable planning, lacking venture association, wasteful structure, and poor incorporation. Evidently, megaprojects operate in a risky environment as demonstrated in past studies. Specifically, Flyvbjerg (2003) noted that ninety percent of all projects exceed their projected budget. Noticeably, infrastructure projects such as rail work exceed their estimated budgets by close to forty-five percent. Moreover, Flyvbjerg (2003) noted that the overrun in rail projects does not deter their demand; in fact, statistics show their demand increase by at least 51%.  Megaprojects are often set up to generate at least 20% of the capital, thus, overruns eventually lead to losses on the part of stakeholders who took the risk or the government. Further, Haidar and Ellis (2010) added, insufficient specialized structure, absence of premonition, specialized troubles, changes of determinations, scope creep and presentation of megaprojects to unforeseen exogenous stuns, in connection to costs, benefits, and different parts of arranging. In any case, megaprojects are helpless to poor track records as far as fruition times, cost accelerations, and deficiencies in anticipated incomes and financial advantages are concerned. In line with the above claims Siemiatycki (2012) emphasizes that PPPs can help to alleviate the constant difficulties in customarily conveyed megaprojects, by exploiting the social systems among governments and private financial specialists taking part in foundation megaprojects. In any case, PPPs have assumed a huge job in open framework conveyance in the most recent decade over the globe.

Overall, this is a crucial administration issue that frequently prompts delicate megaprojects— megaprojects self-destructing as a result of the absence of bearing and shared conviction (Merrow, 2011). In addition, Megaprojects are frequently driven by organizers and project managers without complete comprehension and area experience, which might make frail administration and broken authority designs. Moreover, a lack of knowledge makes it difficult for leaders in mega projects to synthesize information from the concerned disciplinary fields, thus, impeding their ability to perform from a professional perspective. Megaprojects frequently expand on non-standard innovation and structure, which shapes a uniqueness predisposition among organizers what's more, supervisors who will, in general, consider their projects to be as troublesome contrasted and different ventures, in this manner making it hard to gain from history and experience.

Notably, the above challenges are notable in different types of megaprojects and nations, however, there exist challenges of megaprojects commonly observable in developing countries. For instance, the projects that require a high-level design and specialized aptitudes; able HR and administrative abilities just as unnecessary cost venture. Most developing countries lack the aforementioned prerequisites for successful advancing megaprojects. Moreover, the magnitude of megaprojects has brought forth challenges related to capacity. The successful advancement of megaprojects is typically handled by more than firm from different national backgrounds as demonstrated by Fox lee and Lyon (2019) who claimed that domestic firms within host countries of megaprojects often need help from international partners to effectively deliver on their mandate. This implies project managers are being compelled to pick between paying more for a consortium of experienced local firms despite their relatively lower level of experience against more experienced international companies. The above decision is typically difficult especially when there are political motivations behind the initiation of the megaproject. Maybe as anyone might expect capability is additionally turning into an issue, especially at the administration level. In fact, as undertakings become greater and greater, it is ending up progressively hard discovering people with experience overseeing ventures of such gigantic size and unpredictability. Essentially, as ventures get greater and increasingly perplexing, they are winding up intrinsically progressively risky. That makes it progressively hard for project managers to keep their nerve when things begin to turn out badly. In this condition, we hope to see venture proprietors locate another hunger for benchmarking, dissecting execution and taking in exercises from other fruitful tasks internationally as they try to protect ventures against political and monetary weights. An additional challenge of megaprojects discussed in this investigation is the weakness in organization design and capabilities; this is especially related to the position taken by the project manager of a megaproject. Evidence indicates that project executives are expected to take full control of the success of mega projects, however, they have situated at least four levels down the leadership ladder of the organization. Such as structure makes it difficult to make coherent and cohesive decisions as each layer of leadership has specific goals it aims to meet. For instance, lower levels may be concerned with cost and timely completion while upper levels are more focused on the return on investment.  Such incongruency of goals in megaprojects may lead to misalignments and eventually lead to challenges in meeting a megaproject’s success criteria. In addition, project managers may be faced by challenges in decision-making as the organizational structure does not allow adequate control. Abilities, or scarcity in that department, are another issue. Megaprojects are ordinarily either supported by the legislature or by a businessperson with intense goals; they can take 10 to 15 years to wrap up. Indeed, even people who take leadership roles in megaprojects have inadequate experience considering the meagre number of mega projects they manage in their lifetime. Notably, every megaproject is unique and requires extensive learning and comprehension within a short duration of time. Thus, the skills to effectively manage a megaproject are quite rare. In fact, the tasks required to be undertaken in the initiation of a megaproject can be compared with starting a new firm with new recruits. Evidently, the nature of megaprojects makes it difficult to effectively manage from an administrative perspective.

Another impediment of megaprojects is low efficiency. Even though recent technological advancements have seen an overall increase in efficiency across most industries, researchers have noted that discrepancies in project productivity still exist. For instance, productivity in manufacturing has significantly improved as compared to construction; thus, it is important to encompass the sector within which a project is engraved to effectively make judgments about its productivity. Another key factor related to productivity is the ever-growing nature of wages as they overweigh expansion in business sectors primarily involved in megaprojects hence bringing about greater expenses for similar outcomes.

### *2.6 Summary*

The world needs megaprojects to convey the financial and social merchandise that billions of individuals need and to make the monetary development that will pay for them. Stakeholders and proprietors need to play a functioning job in assembling the project team. It isn't sufficient for them to have an unclear hypothetical outline of how the venture should function. The above chapter described the features of mega projects, in the context of project management, decision making, and cognitive bias. Evidently, the definition of Megaprojects is not limited to certain fields such as infrastructure since other Mega Project may involve the development of cures to diseases or ways to handle massive amounts of data. From the discussion, it is obvious that most Megaprojects fail to adequately meet the criteria to be termed successful. Even when the project meets the expected specifications, there is a high probability some aspects of the project may be deemed unsuccessful. For instance, a project may end up delivering the project benefits to a local population but at extremely high costs, time and negative impact on the environment.

Interestingly, the number and magnitude of Megaprojects on the globe is increasing despite the limitations, challenges, and perils observed in failing projects. This has largely been attributed to a desire to meet human developmental needs. By contrast, the actual execution of individual projects is rife with bias such as optimism bias that prompts project managers to over-estimate future benefits and underestimate costs. In addition, the chapter also described the challenges project managers face when dealing with mega projects in view of the different phases of mega projects. They have to make a point by point, pragmatic way to deal with arrangement with such likely projections as overseeing provider. An accomplished venture director isn't sufficient; players must amass a group that has all the essential aptitudes, including lawful and specialized ability, contract the board, venture revealing, administrative endorsement, partner the executives, and government and network relations.

# Chapter Three: Cognitive Biases and Decision Making

### *3.1 Introduction*

The ensuing chapter defines, describes and elaborates on cognitive biases with respect to decision-making in Mega Projects. The discussion on cognitive bias and decision making is presented separately to allow a more detailed discussion. Twelve cognitive biases are explored to suffice the discussion since the biases are linked to personality traits, demographic characteristics, cost-overrun and decision making in this research. Further, the discussion on decision making explores fours spheres; they are decision-making styles, theories, risk decision making and the interplay between decision making and mega projects. Ultimately the aim is to link cognitive bias to cost overrun, and individual personality traits of project managers and how it influences their decision-making capacities. The motivation for exploring personality traits in conjunction with cognitive bias is because of the association between vulnerability to specific cognitive bias and personality traits. Furthermore, research discussing the link between cognitive bias and psychological traits such conscientiousness are discussed in this section.

### *3.2 Cognitive Biases*

A cognitive bias is a tendency to perceive information in reasoning and which affects a person's judgment and decision making (Cherry, 2019). Some of such biases are connected to a person's experiences and preferences. Cognitive biases cause a person to judge and make decisions which diverge from rationality. According to (Winterfeldt, 2015), it is a systematic incongruity between the supposedly correct answer in a task that involves, given by a formal normative rule, and the actual answer of the expert or the person making the decision. This type of preferences takes place when people attempt to carry out the interpretation of information in their surroundings. More definitively, it is a consequence of when the brain tries to make information processing simpler. These biases enable a person to make sense of their environment and the world. Before actual decision-making, data needs to be collected and analysed. The algorithms involved in the analysis of information in human beings are typically susceptible to the cognitive bias that arise out of false associations and probabilistic way of thinking which is prone to error (Coaker, 2015). Although the errors in collection and analysis of information may be systematic, they are at times predictable and can be understood. For instance, the human brain is known to distort, modify and even neglect information that has been collected without realizing it because of different biases. Additionally, the process of isolating and analysis of information by the brain is known to be an origin for several biases.

The operation of the human brain is in two aspects, the first aspect manages the reflex and uncontrolled mental process resulting to spontaneous and natural actions whereas the second is relaxed handling actions that need attentiveness and strength of mind hence tends to be more analytical and purposeful (Cunha, et al.,2014). The selection of choices individuals makes depend on guesses, heuristics, and rules of thumb, whether it was planned intentionally or unintentionally and with time these actions become evident as cognitive biases (Dimara et al., 2015).

Cognitive biases have been described in varied formats. Some scholars label cognitive biases as flaws in mental reasoning that result to actions and choices that are against the commonly acknowledged values whereas cognitive bias has also been recognized as a logical way of differing from the known conventional statute (Montibeller and von Winterfeldt 2015). As well, Pohl (2016) refers to cognitive biases as a mental occurrence with five characteristics which are consistently diverging from certainty, happens in a regular pattern, comes about unwillingly, evading is problematic or unlikely and looks like it is diverging from the ordinary way of facts handling, therefore, a cognitive bias is a cognitive occurrence comprising of a foreseeable way of differing from realism and comparatively unfailing on persons.

As one of the cognitive bias, heuristic occurs when an individual relies heavily on the first information to reach his or her mind (Cherry, 2019). As a consequence, the individual then engages in acts that are reliant on that kind of information. For instance, when an individual is faced by a situation where they ought to make a decision a number of hypothetical scenarios may be recalled helping conclude which are the most probable. Ultimately, this may cause overestimation of the probability of occurrence of such situations or events. A heuristic is at times an important type of cognitive bias. However, it is worth taking note that it causes errors and mistakes associated with decision making. Further, the bias occurs unconsciously thus making project managers and leaders involved in decision making susceptible to their own predispositions and errors in thinking and reasoning (Kahneman, 2011). Further, Kahneman(2011) claimed that the heuristic cognitive bias operates on the concept that if an individual can think of an idea, then the idea must be important.

The halo effect is a bias whose mode of functioning is that the overall impression a person creates in the people around him or her shapes how they think and believe with regard to their character (Cherry, 2019). Moreover, it also determines how people feel about him or her (Cherry, 2019). The overall impression is determined after the assessment of some of his or her traits. An instance of the halo effect was given by Vieth(2012) who claimed that politicians leverage heavily on the bias to gain support from their followers. In specific, Vieth (2012) argued that politicians work a lot on proving they are capable and likable than actually demonstrating how well informed they are to enable them to lead the country. When individuals rate people as being attractive or good-looking, they are also made to believe that they have intelligence and that they generally have positive traits. Magistrates and judges are less likely to believe that good-looking and attractive people are guilty in a criminal offense.

Self-serving bias occurs where people tend to believe that every good thing happening is because of their own effort. People tend to always want to take credit for every positive thing that comes their way (Chrysikou,2016). On the other hand, individuals blame other forces for the negative happenings in their lives. The cognitive bias is helpful since it helps people protect their esteem. By attributing failures to external forces and successes to themselves, their self-esteem gets preserved (Chrysikou,2016). It has been widely observed that several factors influence this bias for instance gender and age. Those of the old age are more likely to attribute success to themselves. On the other hand, men tend to believe that the most successful things that happen in their households are attributable to them (Chrysikou,2016). Self-serving bias, although it helps in protecting one's self-esteem, it leads to faulty decisions since the person making the decision will reach a conclusion without considering all the factors that might have contributed to the outcome.

Functional fixedness is another cognitive bias which causes a tendency to view things or objects as serving only one particular function (Chrysikou,2016). Functional fixedness bias prevents people from seeing the full range of the functions an object can be put to (Chrysikou,2016). This kind of cognitive bias has an effect in decision making and consequently in problem-solving as the person fails to think of other alternatives which can serve as solutions to his or her problems. According to Chrysikou (2016) on his elaboration of cognitive bias states that "given the apparent link between pictorial stimuli and information related to an object's canonical function and mode of manipulation as discussed above, pictorial stimuli may induce functional fixedness to an object's normative or depicted use during creative problem-solving." As much as examples can be pretty useful in the facilitation of creativity by use of analogical transfer or by constraining the creative task space (Sagiv, Arieli, Goldenberg, & Goldschmidt, 2010), they also have a negative facet as they can lead to functional fixedness, thus limiting the generation of novel ideas. We recognize predispositions in choice and hazard examination that is hard to address versus inclinations that are anything but difficult to address. Inclinations that are hard to address will, in general, be impervious to rationale, disintegration, or the utilization of preparing and instruments. The overconfidence bias linked to over optimism bias in this study and anchoring bias is among the easy to correct. Rationale and disintegration are the most widely recognized approaches to dispense with predispositions that have been mentioned above. These can be redressed by showing the likelihood rationale, and the disregard of base rates which can be fixed by inspiring base rates and restrictive probabilities independently. This refinement holds just for intellectual inclinations—conversely, all persuasive predispositions in choice and hazard examination are difficult to address.

Kahneman et al (1982) investigated cognitive biases using a broad spectrum of lab testing and discovered that cognitive biases may develop three main heuristics that are representativeness, availability, and anchoring. Virine and Trumper (2008) grouped numerous cognitive biases into four categories which are

(a) Behavioral and perception biases

(b) Estimation of probability and belief biases

(c) Social and group biases

(d) Memory biases and impacts.

To understand better the impact of cognitive bias in decision making, it is paramount to look at some specific types of cognitive biases and how they affect decision making. Below are some of the different types of cognitive biases discussed in relation to how they impact decision-making.

*3.2.1 Controllability Bias*

Control is a manner in which an official contract is created for explaining the privileges and accountabilities of each individual and monitors the output to attain required results (Wang, Fang and Fu, 2019). Controllability is showcased by the illusion of Control individuals have to overrate the sway or dominance on dynamics that are outside their scope such as rates, expenses, demand, and the stock market and sometimes the inspiration is strong such that the individual ruminates he or she can predict the outcome of unsystematic selections such as the toss of a dice or coin (Hetemia, Merea, Nuurb and Engwall, 2017).

*3.2.2 Availability*

Availability bias happens when an individual makes decisions on a particular issue based on the possibility of recalling related issues (Kahneman et al., 1982) and the bias thus favors the decision that can be brought to mind effortlessly implying that these decisions may sway towards being exaggerated (Montibeller and von Winterfeldt, 2015). The inclination happens when the likelihood of an occasion that is easily recalled is exaggerated. Over time individuals can reduce the impacts of the availability bias by engaging in probability training, leverage instances that go against easily recalled information and using the power of insights from statistics instead of any easily recalled information.

### *3.2.3 Anchoring*

Anchoring bias exists when a person approximates a numerical value based on a reference value that is labeled as the anchor, after which the value is then unsatisfactorily modified to generate the absolute answer (Montibeller and von Winterfeldt, 2015). Kahneman et al. (1982) explains anchoring as the dependence on one feature or fact in decision making and could involve determining answers using a preliminary anchor but neglect to accordingly make necessary amendments before the final decision. The inclination happens when the estimation of a numerical worth depends on an underlying worth which is then deficiently acclimated to give the last answer. Researchers recommend that decision-makers should be aware of this bias, maintain a strategic distance from anchors, provide counter anchors or follow experts who used different anchors to effectively mitigate the effects of the bias on their overall decision making.

### *3.2.4 Confirmation Bias*

Confirmation bias is present when an individual wish to ratify their opinions by unknowingly finding and applying proof when making decisions (Montibeller andWinterfeldt, 2015). For example, many people consult while wanting to make imperative choices like depending on consultants for assistance with projecting or approximating the possibilities of various forthcoming results. Farmers depend on whether foretellers to assess the rain while business experts use sales predictions to provide the means of achieving the sales targets (Stavrova and Evans, 2019) Confirmation bias is a type of cognitive bias which involves favouring or literally confirming a pre-existent belief. For instance, a person might be holding a belief that all rude kids are smart academically, if it happens that this person meets a lid that is both rude and smart academically, he or she will tend to place more weight on this kind of proof, following the fact that it proves his or her belief. This individual will be prompted to look for more evidence that supports this line of thought and disregards all the evidence that does not support his or her idea. This type of cognitive bias has an impact on individuals' mode of information collection, interpretation and recalling. For instance, the people who are in support of a certain idea will be collecting information in a way that only supports their belief. Such people will also interpret information reaching them in a manner that their already existent ideas will be upheld (Cherry, 2018). The aforementioned further impacts how they recall the details of information using an approach that provides reinforcement to their already existing beliefs.

Human beings tend to be more inclined to search for information that will support the ideas that they already believe (Preston,2012). In turn, the above-described trend in reasoning hinders their objectivity when looking at imminent scenarios. In the end, the decision-making capacities of individuals are affected by the subjective view that leads to biased conclusions. In mega projects, such biased could lead to unexpected outcomes as the actual situation on the ground is considered in the context of a bias. This research notes that the confirmation bias may affect decisions related to cost overrun resulting from poor projects. In addition, the above bias is also linked to personality traits amongst project managers, CEOs and key stakeholders in Megaprojects. An instance of confirmation bias is when people have to choose to whom to vote in an election. With confirmation bias, these people will tend to first have a favorite candidate and then begin looking for the positive aspects of such a candidate to justify their choice to vote for them. Similarly, they will be biased towards looking for defects that their non-favorite candidate so as to satisfy their choice of not voting for them. Similarly, previous experiences of individuals involved in decision-making may impact how they interact with new scenarios and challenges involved in executing operations of mega projects. The predisposition happens when there is a craving to affirm one's conviction, prompting oblivious selectivity in the procurement and utilization of proof. To alleviate this bias, individuals are advised to adopt multiple perspectives about their queries or suppositions. Further, the bias can be eliminated by challenging likelihood evaluations with counterfactual and conduct tests to determine whether alternative hypotheses can be pursued.

Confirmation bias is one of the kinds of cognitive biases which involves favouring or literally confirming a pre-existent belief. According to Preston (2012), confirmation bias has an impact on individuals' mode of information collection, interpretation and recalling. For instance, the people who are in support of a certain idea will be collecting information in a way that only supports their belief. Such people will also interpret information reaching them in a manner that their already existent ideas will be upheld (Cherry, 2018). This further impact how they recall the details of information using an approach that provides reinforcement to their already existing beliefs.

Even though the above description depicts confirmation bias in a negative light with regard to decision-making in megaprojects; Sanderson(2010) points out the positive side of confirmation bias that it is useful in the formation and re-confirmation of the stereotypes that people have about events and other people. The aforementioned could be useful at times, however, in this investigation confirmation bias is viewed in the context of faulty decision-making in mega projects. Therefore, the discussion will focus on the avenues through which confirmation bias affects project managers' view of risk, escalating costs, and other aspects that pose a threat to the success of mega projects. Chrysikou (2016) carried out a study that focused on the impact of verbal and pictorial approaches in exemplifying divergent and creative thinking. In the study, the researcher carried out an examination of the retrieval of memory of a person based on both the influence of verbal and pictorial stimuli (Chrysikou,2016). The aim was to examine whether there existed differential bias on the participants' responses. From the task assigned to participants, Chrysikou (2016) was able to systematically manipulate the extent to which participants are were issued with open or closed questions. On completion of the task, Chrysikou (2016) observed that participants, depending on the nature of the task undertaken, demonstrated different biases toward top-down or bottom-up semantic retrieval strategies. Specifically, Chrysikou (2016) observed that the generation of canonical uses occurred in a faster manner compared to secondary and ad hoc uses. Secondly, Chrysikou (2016) showed that even though more top-down strategies were employed by the participants as compared to the bottom-up retrieval strategies, the creative tasks that were open-ended and that involved the generation of secondary and ad hoc thinking had the participants generating responses that were based on the bottom-up retrieval strategies. Thirdly, Chrysikou (2016) observed that effects of stimulus type (name, picture, or a combination of the two) on the availability of object properties for retrieval was more noticeable at the time of the generation of ad hoc, uncommon uses.

Actor-observer bias is such that there are two parties, the observer and the actor (Kahneman, 2011). Specifically, it occurs whereby a party (observer) attributes the actor's failures to internal sources and his or hers to external forces. Further, it is obvious that the actor-observer bias is sometimes an issue and so problematic. This follows the fact that it can even lead to unnecessary arguments. With regard to decision making, this type of cognitive bias has a negative impact because the actor cannot seek to correct the negativities occurring to him/her and can at times attribute them to external factors that are even out of control, even when the actual reason for the negativities are majorly internal (Chrysikou,2016). When individuals are faced with a situation that requires the making of an important decision, individuals tend to attempt to explore all the possible options that may be available to them. But how often individuals pursue all the options available for them? As much as individuals would always like to explore all the options available to them, most times they do not exhaust them. As a result, their attention shifts to the few options that they can think about and eventually they leave out other available options. The above-described scenario is known as an attentional bias which is another cognitive bias included in this research even though it is not measured statistically (Chrysikou,2016).

The tendency of individuals to pay more attention to negative stimuli as compared to positive or neutral stimuli is a key feature of attentional bias. Over time, the bias has been attributed to evolutionary mechanisms to aid in survival. Specifically, Cherry (2019) states that “in order to ensure survival, our ancestors were more likely to survive if they paid greater attention to risky things in the environment and ignored things that did not pose a threat.” Attentional bias has an unimaginable impact on the decision-making process; thus, its inclusion in this investigation. This cognitive bias can lead to faulty and erroneous decisions by project managers in charge of Megaprojects. The misinformation effect is a bias that occurs when reporting an event later after the event has taken place. There is always a tendency of putting forth information in a manner that is not accurate as it occurred. While trying to pass information an individual might add subtle details to the details in an attempt to explain it better depending on how one can remember such information. The post-event information has a great tendency of interfering with the original memory of the event. Thus, there is a confusion between the verbal description of the events that the informer is reporting with the visual experience gained when the event takes place (Arndt, 2012). Brent (2018) states that "the misinformation effect refers to the impairment in memory for the past that arises after exposure to misleading information." Misinformation effect has a huge negative impact on the decision-making process. The effect leads to eventual false information reaching each and every person in the chain of information. If the information is used to make a decision, one would definitely reach a misinformed decision. Sarah (2018) explains the misinformation effect using a study carried out by Loftus long ago. The classic experiment dated back to 1974 where the researcher conducted interviews on a number of participants (Sarah,2018). The participants viewed a video of an accident involving two cars. They were later on questioned on what the saw on the particular video. Depending on the wording of the questions and other factors, the answers to the questions did vary (Sarah,2018). When the student asked the question, "how fast were the cars moving just before they smashed on each other?" most of the answers would suggest that the cars were moving with extremely high speed. It was a whole different case when the question was posed as, "how fast were the cars moving when they bumped into each other?" the kind of responses received from the latter would suggest that the cars were moving at a lower speed as compared to the responses to the former question (Sarah,2018). Further, when the participants were approached a week later and asked whether there were broken glasses at the accident scene, the ones that had heard the term "smash" had more tendency to answer that there were pieces of broken glasses at the accident scene while actually in the video they had watched there were no broken pieces of glass. It is therefore quite observable that the misinformation effect and the long-term memory casts skepticism on the reliability and the admissibility of the witness statement made by an eyewitness, a kind of testimony that is widely relied upon in criminal cases. False consensus effect is the tendency of people to do an overestimate of the level to which other people are in agreement with their beliefs. The bias is characterized by the tendency of people to believe that their ideas and beliefs are normal and that several other people share the same opinion (Sarah,2018). This kind of cognitive bias can lead to someone making a decision affecting other people in a way that will disappoint them due to his belief that they would definitely agree with him.

*3.2.5 Cognitive Dissonance*

The cognitive dissonance bias refers to a scenario where individuals experience conflicting beliefs, attitudes and/or behaviours. Consequently, the conflicting constructs described above lead to the dismay and agitation. In turn, individuals become subjects of cognitive biases that seek to eliminate the discomposure caused by the conflicting beliefs, thoughts or attitudes. In mega projects, cognitive dissonance on the part of project managers may impact their decision-making capacities thus, affecting the overall success.

*3.2.6 Dread*

Dread is among the least mentioned cognitive biases in research; this type of bias is often related to the extent to which losses have a greater impact on the emotions of individuals as compared to wins or gains. Similarly, researchers conceptualize dread as the fear of events that may have extremely detrimental impacts. Gomez and Villar (2018) propose that dread or the fear of extreme loss or damage should be viewed in the light of cognitive shortcuts and heuristics adopted by decision makers. In this investigation, project managers are viewed as susceptible to dread due to the psychological pressure associated with successful executing megaprojects. Further, dread in project managers arises from their fear that the project may fail or major events may cause extensive damage to progress. Notably, dread is often discussed in the context of risk and uncertainty which are primary factors modeling decision-making by project managers.

#### *3.2.7 Familiarity*

According to Boussabaine (2014) familiarity is closely associated with availability bias described in an earlier section. Fundamentally, familiarity refers to the predisposition of individuals to make judgments founded on scenarios that are recognizable or well-known to the decision-makers (Boussabaine, 2014). The past knowledge of decision-makers to a specific risk or scenarios influence their decisions, therefore, individuals displaying high levels of familiarity are more likely to pursue higher levels of risk (Boussabaine, 2014).

#### *3.2.8 Hindsight*

Hindsight refers to the tendency of individuals to perceive that events are predictable based on the fact the event already occurred in the past (Cherry, 2019). More clearly, individuals may contemplate on the predictability of an event when it has already occurred. For instance, individuals may perceive that the results of an election were predictable only after the full tallies have been done (Cherry, 2019). The aforementioned psychological inclinations may affect the beliefs and even behaviours of individuals. In megaprojects, managers and key stakeholders involved in decision-making find themselves subject to this bias especially when it involves the success of the project. Once an event has occurred in the megaproject, individuals may believe that the event was predictable, thus, adopting behaviours, beliefs, or decisions as a result of that inclination.

### *3.2.9 Scale*

Scaling bias is a group of related biases that are instilled through a stimulus and the person shows the bias by responding to the stimulus and the bias entails contraction bias, logarithmic response bias, range equalizing bias, centering bias, and equal frequency bias (Montibeller and von Winterfeldt, 2015). A group of stimulus reaction predispositions that involves withdrawal inclination, logarithmic reaction inclination, extend levelling predisposition, centering inclination, and equivalent recurrence inclination. Create scales that match upgrades and reactions, monitoring these inclinations. Additionally, scholars recommend choosing suitable scaling procedures for the job needing to be done to reduce the scale bias.

### *3.2.10 Representative Bias*

Representativeness bias is shown by the inclination towards claiming that a particular issue A is dependent on another factor B and influences decision making by envisaging that the observation made or is anticipated to happen to have higher chances of occurring (Kahneman et al., 1982). Representativeness heuristic inclination happens when the closeness of items or occasions confounds individuals' reasoning with respect to the likelihood of a result. Individuals habitually wrongly believe that two comparative things or occasions are more firmly connected than they really are. This representativeness heuristic is a typical cognitive error that concerns researchers in behavioural finance.

### *3.2.11 Optimism Bias*

Optimism bias is also known as wishful thinking or the attractiveness to a positive event or consequence and is observed when an individual has a heightened view and anticipation for a result to happen (Montibeller and von Winterfeldt 2015). Psychological studies state that the impractical optimism is based on conclusions for upcoming subjects, for instance, most people are likely to overjudge their possibility of having good life occurrences (Stavrova and Evans 2019). This is a kind of cognitive bias occurs when individuals believe that they are more likely to have good things happening to them compared to others. At the same time, individuals hold on to the idea that they are less likely to have bad things come their way than other people. Optimism bias is a cognitive bias whereby individuals believe that they are more likely to have good things happening to them compared to others. At the same time, they hold on to the idea that they are less likely to have bad things come their way than other people. Optimism bias was elaborated by Shepperd (2015) who made a finding that most of the students in college had the belief that they had lower chances to get divorced after getting married or developing a problem of drinking as compared to others. The students also had the belief that they had better chances of having good lives and growing old happily were higher than those of the other students. Optimism bias affects decision making, causing a person to make decisions poorly, which may lead to grave outcomes. An observation has been made by a neuroscientist that this kind of cognitive bias is prevalent in the whole world and is widespread in all the world cultures (Sharot, 2011). The huge reason for this under-estimation has been conceptualized by research to be positive thinking inclination commonly attributed to over optimism (Kahneman and Tversky,1977). Further, Flyvbjerg (2006) characterized it as "an intellectual inclination found with a great many people to pass judgment on future occasions in a more constructive light than is justified by genuine encounter". Comprehensively, it implies that individuals, when requested to estimate the future, don't think about history or unanticipated occasions. Subsequently, the generally new strategy of catching and surveying exercises figured out how to gain from past undertakings might be one-sided too. over optimism, the inclination is a procedure of our mind that aids judgment (Shepperd et al., 2002) and can be depicted as the manner in which individuals really think in contrast to the way individuals conceptualize their thoughts. Individuals tend to believe that there reasoning is sensible and balanced wherein certainty it is very in opposition to that.

#### *3.2.12 Venturesomeness*

Venturesomeness is closely associated with the personality trait venturesome. Essentially, the construct is related the tendency of individuals to take risks. Therefore, individuals displaying high levels of venturesome behavior have a higher affinity for pursuing risks and accepting their outcomes (Boussabaine, 2014). According to research such individuals typically understate the risks due their adventurous behavior and perception that they are in control of such situations (Boussabaine, 2014). Scholars classify Venturesomeness as personality trait that increases susceptibility to optimism bias (Boussabaine, 2014).

### *3.3 Decision Making*

Decision making has been a topic of interest for a long time and currently, there is a profound concern in understanding decision making due to its importance in daily living (McFall, 2015). Almost all human endeavours involve selecting one choice over another and in the process, decision making happens (Uzonwanne, 2016). Essentially, decision making is the core of human living and operating where people choose their surroundings and eventually their own destinies (Uzonwanne, 2016).

The popularity of decision making in various aspects of handling situations has initiated different opinions regarding decision making where a number of theories have been formulated to expound on this issue signifying that scholars are not only concentrating on answering research questions in their investigations but are more inclined to provide information and solutions for each and every situation that arises (McFall, 2015). According to Eduards (1954), decision-making theory assumes three issues, the availability of choices, decisions are in an organized manner if not, decision making cannot be effectively studied, and decisions are directed towards particular aims, therefore, decision-making theory is based on choices and individual objectives attitude. In the same line, Oliveira (2007) views the principle of decision making to assimilate a person's notion about a particular issue and the response of that person to that issue, for example, decisions responding to issues are viewed in three dimensions; firstly, options are available, secondly, a perspective of the results is created to describe the possibility of occurrence of the options, and lastly, the actual result is evaluated by examining the individual characteristics and the objectives.

Above and beyond fitting in principles and anticipations, decision making procedure involves scrutiny of the issue by disintegrating an option into groups of lesser subjects to ease problem-solving through ensuring every matter is handled individually. It means that the investigation undertaken during decision making makes available a proper way of comparing the outcome of the decision with the decision itself after which a temporary option could be selected (Oliveira, 2007). Further, Oliveira (2007) proclaimed that to appraise the investigation procedure for identifying the motives behind selecting a specific option, the decision maker needs to be open and flawless regarding the outcome of the decision.

Decision making may simply be defined as the thinking method of choosing a reasonable preference from the wide selection presented alternatives (Uzonwanne 2016) and so decision-making styles are the acquired routine way of a person when met with a scenario that requires decision making (Scott and Bruce 1995).

### *3.3.1 Decision-Making Styles*

According to Scott and Bruce (1995), decision making styles are clustered into four scopes. Firstly, rational decision-making style which entails extensive inquiry for and sound assessment of options; secondly, Intuitive decision-making style which concentrates on adopting premonitions; thirdly, Dependent decision-making style where guidance is sought from other parties, and fourthly, avoidant decision-making style where the decision maker evades making an option In this study, the focus is on rational decision making and intuitive decision making because, in the study, decision making is not an option making avoidant decision-making style not applicable and dependent decision making has been considered as a personal trait and not as a way of making decisions.

#### *3.3.1.1 Rational Decision Making*

Rational decision making has been elucidated in terms of intuitive decision making in that it is the reverse of intuitive decision making where evidence and information, scrutiny of the collected data, and a methodical approach is applied to find the option to select making rational decision making a more sophisticated way of making choices (Uzonwanne 2016). Rational decision-making focuses on the lasting results of the decision and includes enough evidence to support the decision hence the rational decision making can be explained by being intentional, investigative, and reasonable (Russ, McNeilly and Comer 1996).

In rational decision making, reasonable assessment is undertaken that consists of collecting relevant information, using common sense to arrange and examine the information such that it can provide basis for making the most correct decision and by considering the characteristics of rational decision making, it is the most probable decision making that is used by senior managers to select a solution through undertaking comprehensive analysis of factual information and using probability measures to gauge probable substitutes from diverse settings (Uzonwanne 2016). Therefore, rational decision making is used when the decision consequences have great impact such as an increase in costs for projects, and therefore, the decision is made after ensuring dependable information is collected relating to the subject matter and analysed so as to provide a successful decision since a thoroughly investigated issue usually leads to an efficient resolution (Uzonwanne 2016).

Oliveira (2007) describes rationality as the integration of selection and significance implying that rational behavior strives to boost the significance of the results, therefore, the main intention of rational decision making is to choose as opposed to looking at the choice. In management research and practice, rationality in decision making is indirectly or clearly deliberated as the best way to handle issues even in situations that wholly inhibit a rational view (Calabretta, Gemser and Wijnberg 2017). Although this approach has been acknowledged to be effective, the efficacy of the decision will rely on the ability of the decision maker to gather enough and relevant information to be analysed and for the decision to be made making this process depends on the information available to the decision maker (Uzonwanne 2016). Further, due to its organized structure in analyzing information before making a decision, rational decision-making takes time and much effort hence it is not suitable in scenarios which require urgent decisions, have high complexity, and those settings with lack of clarity in how decisions are made (Calabretta et al 2017).

*3.3.1.2 Intuitive Decision Making*

There has been no clear definition to the notion of intuition (Julmi 2019) prompting this view to be contradictory but a globally acknowledged description is provided by Dane and Pratt (2007) who defined intuition as selections are done based on the effect that is quickly formulated unwittingly and combines various information related to the issue. In this description of intuition decision making, it has been differentiated from analytical decision making in terms of speed of executing the solution, the intention and the manner in which the decision is formulated which follows the widely accepted view that intuition and analytical procedures are two separate ways of mental processing of information concluding intuition is not a way of reducing scrutiny regarding a problem (Julmi 2019). Similarly, research by Wang, Scott, Christopher, Nicole and Thaddeus (2017) in which two meta-analyses were conducted where the first was a meta-analysis of the historical studies and the second was a meta-analysis integrating scales from numerous cognitive styles found that intuition and analysis are not related.

Previously, intuitive decision making had been explained as the selection of an option that is undertaken in a hurry with minimal information at hand and thus it involves the mental processing of information through using instincts to make a decision (Russ et al 1996) which ignored the fact that in intuitive decision making the procedure encompasses of identifying the problem, analyse the problem through amalgamation of facts related to the issue just like in rational information processing, although in intuitive decision making, the phases in processing are much quicker with interrelation of information conducted unknowingly or unintentionally differently from the case of rational decision making where the analysis is undertaken intentionally to provide the best option to choose (Calabretta et al 2017).

Further, Russ et al (1996) proposes that in intuitive decision making, the decision changes when the instinct is not satisfactory and the decisions are prone to mistakes and inconsistency resulting in unclear situations which introduce distrust to the decision maker but Dane and Pratt (2007) noted that decision-makers that adopt intuition, knowingly identify an issue which needs a decision to be made by the insight associated with respective clues and pattern, unknowingly stimulate the mental schemas allied to the issue, unknowingly categorize the relations between the mental schemas and then knowingly provide a resolution and hence intuitive decision making is not inferior to analytical decision making.

In circumstances where the impact of the decision is weighty, intuitive decision making becomes very risky as the outcome might worsen with increase in risk through intuitive decision making is also used when there is urgent need to a solution for an issue or when the situation is complicated and in such circumstances, it incorporates a collection of evidence (Uzonwanne 2016). Paul, Fischhoff, and Lichtenstein (1977) in their explanation of decision theory claimed that decisions made through using opinions have some element of vagueness or unclear settings. In addition to assisting decision makers to handle unclear settings and quickly make decisions, intuitive decision making also excites the mental processes that are fundamental in the initiation of the drive to develop innovative solutions to issues, prompt new ideas, and associated advantages

(Calabretta et al 2017). More, Calabretta et al (2017) noted that even though intuitive decision making is considered to neglect reasonable investigation of the issue before making a decision, the decision usually is followed by an emotion of sureness that the option or options chosen are accurate and important to note is that the sentiment of confidence evolves to be more certain with an increase in the decision maker's area specific aptness. With intuition being applicable in diverse situations, intuitive decision making is discrete with its strong points and flaws (Julmi 2019).

Studies on intuition in management distinguish the kind of intuition between professional intuition and problem-solving intuition where the mental information processing is systemized and rational by using the experience gained over time and thorough knowledge of the issue features Calabretta et al (2017).

*3.3.1.2.1 Herbert Simon's view on intuition*

Herbert Simon in his various literature suggested a unique approach to view intuition decision making and has since been adopted in the creation of the natural decision-making notion and the fast and frugal heuristics theory (Julmi 2019). Simon described intuition as an unintentional way of mental information process that uses the arrangement of similar events to acknowledge acquainted configuration where experience gained over a period of time by the decision maker results to effectiveness in intuitive decision making. With much experience, the decision maker is able to relate upcoming issues with previous issues that were solved through a particular decision and thus the decision maker easily makes the decision subject to the success rate in the previous resolution of the issue.

On the other hand, Simon, does not agree with the notion that intuition and analysis are two separate ways of cognitive processes as he proposes intuition is analysis that has become a habit and using familiarity to recognize the problem, the decision maker is able to make a quick response to the issue (Simon, 1987). In 1993, Simon declared that in his opinion, it is not correct to explain decision making using analysis and intuition approaches as according to him, intuition is a multifaceted method of cognitive information processing that a professional possesses and adopts through experience in a specific field and thus intuition develops through experience that previously applied analytical process (Prietula and Simon 1989). To add, intuition encompasses of analytical process showing that intuition and analysis are two basic corresponding elements of the same cognitive process (Simon and Gilmartin 1973) where the main differentiating factor between the two is that intuition happens unknowingly whereas and analysis is intended but the sense implemented in both processes are the same (Simon 1987).

Using the concept of bounded rationality, intuitive and analytical processes are both limited by the amount of information possessed by the decision maker and hence both can be rational if the attitude shown conforms to the objectives (Simon, 1993).

*3.3.1.2.2 Criticisms to Herbert Simon's view*

One of the criticisms to Simon's notion is that the view does not agree to the reality of actual issues facing decision making which makes decisions vulnerable to diverse explanations and using the proposal that an issue can be disintegrated into lesser attributes so as to ease decision making eliminates the probability of a complex scenario or it can only be applicable when there is no complexity involved which is not the case (Mumby and Putnam 1992).

Likewise, Dreyfus (1999) criticized Simon's view by proclaiming that the view does not consider the implicit structure of cognitive process which is not convertible to the explicit structure such as when people have the capability of managing settings with complexity without having to convert them by a specific function is an implicit structure of mental information process that differs from the known techniques of analytical process (Julmi 2019).

In Simon's view on intuition, the efficacy of either intuition or analytical decision making cannot be gauged and also the view does not acknowledge the possibility of the mental process occurring concurrently as opposed to in a systematic order. Moreover, the view intuition is rational is attributed to the fact that it incorporates analytical process but recognizes the habitual element (Julmi 2019). In the view, familiarity acknowledgment is linked to past decisions that are methodologically formulated but present studies indicate that familiarity is connected to concurrent mental processing (Julmi 2019).

### *3.3.2 Decision Making Theories*

Paul et al (1977) categorized decision making concepts into normative which clarifies the manner decisions are meant to be made and descriptive that illuminate on the way decisions are in reality made, and theories in behavioural decision making expound on the actual behavior of the decision maker.

#### *3.3.2.1 Expected Utility Theory*

When rational decision making is adopted, figures or individual benefits defined by utilities are used to determine the probability of a choice in a group of selections where the choice with the highest anticipated utility is selected (Oliveira 2007). The theory elaborates that personal variances among people are caused by diversity in tastes which introduce diverse cognitive thinking (Embrey 2019).

In this theory, the selections denote the partialities and the theory is described by two approaches. Firstly, is the analytical method in which decision makers initially decide on the selection and then relate to their anticipations by checking the utilities only while the second is synthetic scrutiny where decision makers combine the estimates for utilities and their possibilities to find a choice and is applied when decision makers understand their wants, the manner to attain them and the selections to pick (Oliveira 2007). Notably, decision-making scenarios are different and thus dissimilar utility illustrations and research has shown that people change their decision measures with time and decision scenarios (Embrey 2019)

*Rational Choice Theory*

Rational choice theory is a general phrase encompassing a number of models that are used to explain the social phenomena as the results of individual actions that can be understood to be rational (Wittek, 2013). Ganti (2019) conceptualizes the rational theory by explaining that people depend on rational calculations to achieve results that are in line with their personal objectives. Fundamentally, decisions based on this theory give individuals the best satisfaction or benefit considering the available choices. Notably, people utilizing this theory are suited by the results of the choices they make because they are in the highest self-interest (Ganti, 2019).

The rational choice theory is widely used by the mainstream academic theories and assumptions; the supposition suggests that individuals are in a state where they constantly strive to optimize their gains while simultaneously minimizing the losses that they are likely to face. The specific elements of this theory include the person's preferences, belief, and constraints (Wittek, 2013). The term p*references* refer to both the positive and the negative evaluations that are attached to the possible results of a choice by the people. Preferences can have several bases, for example, the tastes for food or any other things that are culturally transmitted. *Belief* refers to the relations between the cause and the effect; this includes the perceived possibility that a person's actions will give a different possible result (Wittek, 2013). For example, one thinking that pursuing a particular academic course (A) has high chances of securing him or her a job than pursuing course B. *Constraints* refer to the limit of the specific actions done by an individual, for example, the amount of money one has will determine the quality and quantity of items one will buy when he or she goes out for shopping.

Like all theoretical conceptualizations, the rational choice theory founded on a number of assumptions. Over time researchers have identified three prominent suppositions of this theory (Wittek, 2013). The first assumption poses that individuals are motivated by innate selfish desires or preferences (Wittek, 2013). Secondly, the rational choice theory poses that individuals seek to maximize their own utility; and thirdly, individuals carry out their decisions and respective actions independently depending on full information available to them (Wittek, 2013).Notably, there exist several variants of this theory depends on the degree to which the suppositions of the neo-classical model are held where the rational choice explanation is in "thin" versus the sociological ones, in which the above-mentioned strict assumptions get relaxed. The differences manifest themselves in three ways: (1) the type of rationality, (2) preference and; (3) individualism assumptions.

*Rationality*

The neo-classical economics (Thin versions of rational choice theory) make assumptions of full rationality. This is in the sense that persons must be fully informed about all the alternatives, the possibilities for their results, the consequences of their decisions (Glen, 2011). As respects the discernment or handling of the data, there are no intellectual constraints (Glen, 2011). Individuals settle on choices dependent on the estimations that look to profit them as far as expense and choose an elective that brings forth the most noteworthy anticipated utility. Models of bounded rationality, for instance, serve to loosen up the accompanying suppositions: Selective consideration has a constraint on the sum and sort of data, and restricted data handling abilities lead to satisficing as opposed to amplifying (Glen, 2011); the suspicion that individuals have an inclination of tolerating arrangements that are "adequate." The later "thick" social judiciousness models do give explicit conditions under which conditions expansion of increase and other reasonability attributes contained in full-or limited discernment methodologies will control human basic leadership, and under which conditions different procedures, for example, learning or programmed reactions, will manage conduct (Ganti, 2019).

*Preference*

In the “thin” models of the theory, individuals are perceived to be selfish and egoistic, struggling towards material gain maximization (Wittek, 2019). The selfishness in this setting is typically the one that is an advantage where one defies the guidelines so as to fulfill the needs of their targets (Glen, 2011). “Thicker” variants of the theory make an assumption that a person’s behavior can be inspired by social preferences; this means that they are concerned with the well-being of other people. The benefits struggled for by individuals as per this theory are not necessarily materialistic, but also psychological and social benefits (Ganti, 2019).

*Individualism*

Every one of the clarifications of the balanced decision hypothesis depends on the suspicion that each clarification of societal level outcome needs a conduct hypothesis of individual acts as the ground. This is what has grown to be known as "individualism." In the methodological individualism, relevance is not attached to the social structures as behavioral constraints (Wittek,2019). This follows the fact that all the information that is required is encompassed in the subjective meanings or the objective prices of goods. In the structural individualism, social and institutional connectedness is considered as being the conditions that affect the behavior and the decisions of a person (Wittek, 2019).

*Critics of the Rational Choice Theory*

Indeed, even with the above data, the levelheaded decision hypothesis, been rebuked by different commentators that the balanced decision hypothesis has a few issues related to it. The principal analysis of this hypothesis is the way that it is excessively individualistic. As indicated by Crossman (2019), the hypothesis neglects to clarify and assess the way that enormous social structures exist. This is concerning the way that there are social structures which can't be decreased to the demonstrations of people and along these lines, it must be clarified utilizing various terms (Crossman, 2019).

The second set of critics argue that the rational choice theory there is a problem with explaining collective action (Crossman, 2019). In explaining this critique, Crossman (2019) poses the question "if the individuals' actions are based on the calculations of personal profit or benefit, why would they ever choose to do something that will benefit others more than themselves?" The third critique is that the theory that does not give an explanation as to why other people seem to accept and adhere social norms of behavior which cause their activities to be selfless or to have a feeling of a sense of duty that overrides their own interests (Crossman,2019).

*Attribution theory*

The attribution hypothesis is a mental hypothesis whose design is an endeavour to clarify individuals' conduct (Grimsley, 2018). The originator for this hypothesis is Bernard Weiner (1935). McLeod (2012) while characterizing the hypothesis cites Fiske and Taylor (1991, p 23) that "Attribution hypothesis manages how the social perceiver utilizes the data to land at causal clarifications for occasions. It looks at what data is accumulated and how it is consolidated to frame an easy-going judgment." This hypothesis is owing to the way that individuals are dependably guileless analysts who endeavour to persistently comprehend the social world (McLeod, 2018). As indicated by this hypothesis, each individual will need to comprehend why they do a few go about just as why other individuals do what they do. It is an incredible model that decides whether an individual's conduct brought about by inner or outer components; therefore, it is a significant model when one needs to achieve a choice in employment choice. The attribution to which conduct an individual has is identified with three factors to be specific: peculiarity, consistency, and accord (Robbins, Judge, Millet and Boyle 2011).It helps us in the explanation of the persons taking part in a job interview, both the interviewers and the interviewees. Silvester (1997) showed that, for the interviewers, the theory can be important in that it helps explain the ratings that are given to the interviewees by them. The understanding of the causes of certain behaviours can have an effect on the judgment and consequently on the acts of the employees and even the employers in an organization.

Heider put forward two major ideas that form an integral part of this theory, the dispositional (internal causes) and the situational (external causes). The dispositional attribution generally blames the cause of a person's certain behavior to some of his or her internal characteristics, and not external forces. A person's behavior is often attributed to their own personality, beliefs, and motives (McLeod, 2018). According to McLeod (2018), situational attribution is the process where the cause of a certain behavior is assigned to a situation or an event that is outside the person's characteristic or his or her control. These external factors include situational or environmental features.

Attribution of a person's behavior is a three-step process: first, it must be observed that someone's behavior is his own behavior or it is a behavior of someone else; secondly, an observation must be made to determine whether the behavior that is being observed is intentional or not and; the behavior is attributed. While someone's behavior is being attributed, the three things that must be considered include the following:

*Is the behaviour a result of an external or an internal cause?*

It must be observed to ascertain when the causes of the person's behaviour are internal or external. Internal causes as far as attribution are concerned are the factors that are attributable to the individual that is being observed (McLeod, 2018). If an employee is promoted and other employees not, one is likely to believe that the reason for that employee's promotion is the exemplary work that he or she has done during his or her past employment. By believing so, that person will have just attributed the internal causes to the person's promotion. Facades causes are those components that are outside of the person who is the subject to the perception (McLeod, 2018).

*Social Choice Theory*

Kenton (2018) defines this theory as "an economic theory that considers whether a society can be ordered in a way that reflects the individual's preferences." The theory was developed by Arrow (1951). This hypothesis offers a conversation starter with respect to whether it is conceivable to get a standard that assembles the inclinations, decisions, votes, and choices in a way that fulfils the negligible criteria to for what ought to be viewed as a decent guideline. The theory puts all of the individual's choices into consideration, and not just the political ones. Arrow (1951) gives five specific conditions which must be met by a society's choices in order for them to be regarded as reflecting the choices of its individuals. The conditions include responsiveness, universality, non-imposition, independence of irrelevant alternatives and non-dictatorship.

*Positive political theory*

Smith and Banks (1999) lay forth an explanation that the theory "is concerned with the formal theory of preference aggregation for collective choice." The theory is general in that it covers the classes of aggregation methods including the famous majority and unanimity rule and also focuses on the degree to which any given aggregation method is guaranteed result in what is deemed as best alternatives.

*Belief system model theory*

There is a general belief system which can be termed as a deep-rooted belief or ideology. This theory is based on the widespread belief that in decision making, beliefs and ideologies play a very significant role to influence the kind of decisions reached by an individual. This follows that if decisions are to be rational, then they are not supposed to be subjected to the influence of beliefs and ideology. This argument, however, does not stand the test or reality. If the ideology or belief is of a pervasive nature, then the person making the decision has to place significant weight to it and give priority to it in his or her decision-making process. For a communist nation, the policymakers won't settle on such a choice because of the way that such an arrangement will without a doubt be infringing upon the standards and conventions of socialism, in spite of the fact that sanity is sought after of such infringement.

### *3.3.3 Decision Making and Mega Projects Costs*

A project is an activity created by the formation of the impermanent group intended to advance the standing of a permanent group or particular stakeholders through the application of complex problem resolution mechanisms (Cunha et al 2014). In other words, a project is a passing action that is planned to produce a distinctive output (PMI 2013). Many projects experience a high frequency of decisions that compromise the association among cost, quality and incorporeal elements (Rumeser and Emsley 2018).

Mega projects are programs that integrate strategically aligned projects to one very large project (John Eweji, 2012) and are mainly used by companies to deliver key strategic assets as well as key objectives that are universally accepted by all the projects integrated together. John Eweji(2012) in examining the subject of mega projects in the oil and gas industry he notes that since the adoption of the mega projects tactics the industry has overcome all challenges that endangered the industry. Decision making, then again, is a fundamental segment of an undertaking as it decides the results of a project (Priemus, 2010). The connection between decision-making and mega ventures cost is proximal as the expense of the task is dictated by the ideal results of the undertaking (Priemus, 2010).

Decision-making is a rule driven as in the choice that an individual receives predominantly depend on the rules that the individual buys in as well. This includes ideologies and theories that the person subscribes to. The question of how the principles ascribed to a person have on a project, therefore, buy from the link between projects and the decision-making process (Hoshino-Browne, 2012).Decisions of a particular characteristic also give rise to project particular outcomes in relation to the project (Hoshino-Browne, 2012). The many times that decisions have had a negative impact on mega projects, it has been attributed the procedures and protocols that the decision-making process is due to. Where the decision-making process is lengthy and the procedures to arrive at so critical then issues with regards to the project are subjected to a stoppage until when the decision is made. This brings about unreasonable delays and eventually, the project is subject to a delay (Hoshino-Browne, 2012).

From the discussed complexity of megaprojects, they need faster and more productive decision-making techniques that give rise to decisions with an impact on the project. While mega projects are an integration of several projects that relate, the project is subject to different challenges that need more expedient means to address (John Eweji, 2012). Where the project is faced by such a challenge then high-frequency decision making becomes a necessity. Fast decision making brings about the positive attitude towards the project among the managers of the project who are always ready to convene and come up with decisions that realize the achievement of the goals conceived by the planners of the mega-project (John Eweji, 2012).

Ventures don't occur in a conveniently characterized bunch of time, there's a major bit of leeway to having the option to settle on choices progressively to react to occasions at the time (Van de Ven, 2008). Therefore, organizations completing uber ventures need new choices that are intended to fuse low-inactivity handling to affect occasions as they occur such that tends to the complexities wisely and decidedly (Van de Ven, 2008).

High recurrence decision-making is for the most part significant in instances of extortion examination and battling. Megaprojects at many instances are commonly viewed as a chance of originating before for the assets allocated into the task (Muller, 2009). Generally, where assets are siphoned into undertaking different individuals consider it to be a chance to steal reserves and have them in their pockets prompting an expansion in the odds of an event of a cost overwhelm (Muller, 2009). Where a wonder such as this is seen, it necessitates a prompt reason for activity intended to begin examinations to recognize those included and furthermore to keep it from happening or keep its belongings from exasperating (Muller, 2009). The activity that is increasingly feasible in these conditions is the method of high recurrence basic leadership reason being the procedure is swifter, it reacts quick in such conditions and it is progressively confidential.

High-frequency decision-making is anyway subject to different deficiencies which incorporates the way that it doesn't watch conventions like the other basic leadership strategies (Hoshino-Browne, 2012). At numerous such choices are made by the boards of administrators promptly accessible in order to accomplish an answer as quick as would be prudent. It neglects to think about the general population who are customarily expected to take an interest in settling on choice who can't be secured at the material time of settling on the choice (Hoshino-Browne, 2012). The result of this is it neglects to mull over the contribution of each and every partner. In situations where the choice made outcomes to antagonism the individuals who were not associated with settling on the specific choice will, in general, offer a fault on the individuals who were included in spite of the way that the choice was made in accordance with some basic honesty.

The other shortcoming of high-frequency decision-making technique is that it is usually short of proper reasoning. The human mind is designed in such a way that it requires time to make sound decisions (Priemus, 2010). The human mind requires time to evaluate the positivity and the negativity of every possible decision to be taken. The mind then strikes a balance between the positive and negative effects of the decisions before coming up with one decision which considered to be sound (Priemus, 2010). Where there is not enough time the decisions made are decisions that are not well thought of thus are likely to cause problems to the project. In many times it results to cost overrun since the important decisions such as procurement of project raw materials is not figured out well and various markets compared. In the long run, materials required to actualize the project end up being procured at a very high price resulting in a cost overrun (Priemus, 2010).

While managing projects, in most instances, the issues necessitating decision making embroil a wide selection of attributes to be thought through and since generally individuals can concentrate on limited issues at a time, it is evident that an increase in factors identified for examination increases the effort to select a reasonable decision and with this scenarios, project managers make decisions depending on their view of the project (Cunha et al 2014).

Flyvbjerg (2014), refers to the bias that decision makers in mega project experience is caused by the attractive influence of sublimes. The decision makers comprehend the project frame it into a mega project and come up with desired goals relating to the project. The decision is however subject to an attraction to the desired goals of the project (John Eweji, 2012). The success of mega-projects mainly relies on the contemplated goals of the project.

The PMI (2013) ascertains that specialization and overall managing aptness are basic skills for a project manager but to be more capable of better performance, a project manager has need of possessing additional three abilities which are knowledge, performance and personal where knowledge comprises of project management scope the project manager is aware of, performance looks at the dimensions of the project manager's output based on the knowledge possessed while personal encompasses of the project manager's behaviour during project execution or similar undertakings.

The three extra abilities can be categorized into hard and soft skills with knowledge grouped as a hard skill and explains the methods, tools, and procedures whereas performance and personal are soft skills and performance describes the interaction within the team, the rigidity of innovation, making of decisions, and others and personal entails character, personality traits and leadership capabilities (Cunha et al 2014).

The theory of confined rationality as proposed by Simon (1957) elaborates the nature of humans in having a restricted cognitive ability to straightforwardly absorb and configure all of the complexity of their environment forcing them to alternatively create a shortened ideal of reality which they apply to arrive at decisions and believe rationality is within their ideal notion.Turner(2010) appreciates the fact that the theory recognizes the influence of cognition on the decisions making the process by looking at how human nature is designed in such a way that it absorbs the difficulties ambiguities and complexities in their surroundings (Turner,2010). States that this is what expands the minds of human beings and brings about developmental revolutions in the world. According to Turner (2010), the theory involves decision making in the sense that the theory appreciates that human beings brainstorm to come up with decisions that solve the various ambiguities and difficulties arising. Megaprojects experience a lot of complexities and difficulties to solve these difficulties the project leaders and designers come up with decisions which absorb the complexities arising within the project as well as streamline the project to its desired outcomes and goals.

Nevertheless, in actual sense, the ideal view owned by each individual is not essentially the reality prompting Virine and Trumper (2008) to underscore the significance of probing human beings' rationality through questioning whether there are any motives towards the project being in a specific way, what one anticipates from the choices made in a project, and whether the view of the project would change if the anticipations and encouragements are eliminated. In the pursuit of quick answers to the problems facing projects, project managers find it difficult to incorporate this awareness initiating the proneness to cognitive biases (Cunha et al 2014).

Regardless of the determinations to delineate accepted principles, procedures and techniques for managing projects, it is imperative to acknowledge the complexity surrounding projects and especially mega projects which are swayed by every person's human consciousness and their expertise, experiences, personality, reflection, and cultural setting (Cunha et al 2014).

Projects entail compound risks and unclear situations aiming at addressing manifold intentions using a set of several stakeholders' increases the complexity in handling projects (Virine and Trumper 2008). Heightened complexity in mega projects prompts decision makers to depend on a small number of decision making rulebooks, known as heuristics, to reduce the involvedness of making complex decision emerging from the various circumstances and even though these heuristics are frequently essential and convenient in expediting decision making, they present cognitive biases that have the potential of influencing extended and regular miscalculations in decision making signifying cognitive biases are a threat to effective decision making due to the undesirable effect of embracing the individual heuristics (Kahneman, Slovic and Tversky 1982).

Being challenged with the requirement to comprehend the complexity of revolving around their duties and the means of coping with these elements, project managers have unknowingly integrated their core beliefs to their individual resources and experience to obtain solutions relating to these issues (Cunha et al 2014).

Although expertise in a specific field provides advantages of mastery in that field, a section of individual natural precincts affects the mental processes and can result in possible negative decision making (Cunha et al 2014).This has been a point of concern among scholars who have tried to inquire the nexus between individual natural precincts and mental processes and the impact it has on decision making as well as the quality of decisions that it gives rise to (Flyvbjerg, et al., 2008). Decision making in mega projects involves a chain of mental processes that seek to come up with decisions meant to solve the problems arising in the project. (Flyvbjerg, et al., 2008) argues that the more complex a project is the more complex the mental processes involved.

These mental processes include a prediction of the outcome of a decision prior to the formulation of the particular decision (Muller, 2009). Weighing the magnitude of the effects of the decision on the project whether the particular decision will have a negative or a positive impact on the project and lastly weighing whether the adoption and implementation of the particular project will be within the confines of the budget of the project or it will result to a cost overrun on the project (Muller, 2009). These processes occur in harmony so as to ensure that decisions made with regards to the project do not conflict. (Muller, 2009)

Most scholars acknowledge top-down tactic to organize urban megaprojects because the methods initiate an investigation on urban supervision and bottom-up technique to recovering urban land (Zeković et al 2018). Slaev (2017) indicates that in spite of the knowledge of these top-down or bottom-up procedures, the control of mega projects is still very difficult. The bigger the project the more the cost difference and the more the possibility of cost overruns implying lack of satisfactory capability to predict the essential funds and manage mega projects (Sarmento and Renneboog 2016).Additionally, Bodicha (2015) noted that identification of the key success attributes of projects are provisions for supporting project manager's decision making and recommended that project managers need to create a suitable scrutiny method to assist them in eliminating overestimations and underestimations.

Flyvbjerg(2008) states that overestimation leads to the loss of trust by the people interested in the project amongst the various stakeholders. It is construed as a move to defraud and benefit the project managers from the project and at the same time, it raises questions concerning the professionalism of the project managers. The issue of coming up with a method to help eliminate overestimation is highly stressed by who argues that not unless overestimation is eliminated, the project manager's and planners professionalism will always remain in question (Flyvbjerg, et al., 2008).

Underestimation, on the other hand, leads to cost overrun (Hoshino-Browne, 2012). It includes an underestimation of the project complexity, underestimation of the cost of raw materials which eventually leads to an underestimation of the cost required to run the project. It results in a halt of the project as well as massive cost overrun putting the professionalism of the project managers in question (Hoshino-Browne, 2012). Both underestimation and overestimation are a result of poor decision making that arises where one considers factors that ought not to be considered or fails to consider factors that ought not to be considered. (John Eweji, 2012) Notes that decision making is the mother of overestimation and underestimation.

### *3.3.4 Risk Decision making in mega projects*

Normally people have to make decisions by assessing the existing choices in terms of their levels of risk and the person's perception of the probabilities of the anticipations is the risk appetite of that person and is central in influencing the amount of risk the person is willing to take (Schürmann, Frey and Pleskac 2019). The perception of risk by a person has been confirmed to be linked to their procedure of making decisions related to risk using different measures, people, and culture (Schürmann et al 2019). The way individuals make risk decisions is not usually a one-off act constructed independently but it is normally a recurring and vibrant activity (Schürmann et al 2019).

The subject risk is inseparable from megaprojects when viewed from the angle that it gives rise to a project. Cost overrun mainly occurs in the sense that the framers of the project may fail to take into consideration occurrences including catastrophes and risks that the project might encounter and the effects that the risk and catastrophes may subject the project to (Kazaz, 2012). The project may then encounter a risk that the framers of the project did not have in mind that it would occur. Such risks at many find the project at a state in which it was not prepared for mitigation of the loss occasioned this makes it necessary to pump more resources into the project in order to ensure that the project does not stall an action that results to an eventual cost overrun (Kazaz, 2012). This subjects the owners into pumping more resources that were not budgeted for into the project and thereby resulting in a cost overrun.

Risk is however argued to be borrowing much from decision making since it is mainly remedied with decisions and at times avoided with decisions and that at many times it is within the limited scope of control by the project managers or other leaders since risks occur without notice and that no can tell or forecast what risk is likely to occur and when the risk will occur (Kazaz, 2012). Risk decision making is defined as a process which involves a series of basic steps which can add value to almost any situation especially when there exists the possibility of the occurrence of a serious catastrophic outcome. The fundamental point is completing each step in a simple and practical way to provide the information that the decision maker needs to make a decision.

The importance of risk decision making is that it gives a solution in instances where a particular situation relating to the mega-project is so complex that only a detailed risk assessment is needed to address the situation. The assessment shall avail the decision maker with all necessary information to be considered the information includes all possible risk occurrences as well as how to avoid an occurrence of the particular risk as well as how to mitigate the risk in case it occurs. Risk decision making also has the aspect of cases in which risk misinformation occurs. (Priemus, 2010) stated that risk misinformation is by deciding together at an early stage on how information should be treated. This decision includes deciding on what sources of information should be treated as authoritative sources of information. This is to ensure that there is certainty in the flow of information. This extends to a decision on which source should take precedence in cases where information from two or more sources which are all authoritative conflict (Priemus, 2010).

Various theories explain risk decision-making theory (Priemus, 2010) these include the opportunity threat theory. This theory proposes that risk should be analysed as an opportunity and a threat component at the same time which allows the description of behavior as a combination of opportunity seeking and threat aversion (Van de Ven, 2008). This theory further holds that managers should not view risks as of a negative impact but should view risks as an opportunity to address problems arising within the project. Risks define the behaviours as well as the decision-making capacity of the project managers (Van de Ven, 2008).

The other theory is the Modern Decision Theory a theory that has developed since the twentieth century through contributions of various academic scholars and a product of the improvements occasioned on the traditional decision theory (Drennan, 2007). The theory provides that decisions and risks are fewer ones and the same thing that cannot be separated in any way (Drennan, 2007). The theory provides that it is decisions that overlook risks and that it is risks that communicates the quality of the particular decision (Drennan, 2007). These theories explain the shift occasioned on the world towards risks in the sense that risk is deemed as something that is part and parcel of a project that at all times it will always exist as long as projects exist.

Risk is also termed as a performance paradox that mostly results in negative effects on a project yet at many times the risk was not within the scope of control by the manager. The manager ends up bearing a burden he could not control (Drennan, 2007). However, this burden is attributed to the manager on the ground that the risk could be avoided through decision making (Drennan, 2007). Megaprojects with their complexities, therefore, experience more complex risks that can only be addressed with a more complex decision-making process (Drennan, 2007). The procedure of making decisions in so far as risk is concerned varies from one person to the other. Reason being that various people perceive various things differently and that various people respond differently to different occasions (Drennan, 2007). What is risky to one person may be a normal thing to another person and a particular reaction deemed by one person to be appropriate may be inappropriate to another person (Drennan, 2007). On the other hand, the culture that a person subscribes to or that a person was raised in influences risk decision making in the sense that it gives people various differences perceptions towards the various thing.

Procedures for making decisions are also subjected to various challenges especially in circumstances where the decisions are made to address risks likely to occur in the mega project. One of the major challenges is that human beings are reluctant to plan about future problems that once they occur may affect them in one way or another (Drennan, 2007). This has been termed as a fear of the unknown that has costed mega projects for failure to take necessary precautions in cases where risks occur (Drennan, 2007). The procedures of making risk decisions are not catered for at many times because of the blind eye that the subject has been given by project managers. Secondly, risk decision making is faced by the challenge that those that are mandated with risk management planning are an entity different from that entity mandated with the formulation of the plan of the project (Flyvbjerg, 2008). The risk management team at times makes decisions that at times conflict with the work of the project planning team these conflicts make it difficult to synchronize the risk management plan with the project plan (Flyvbjerg, 2008).

*3.4 Summary*

This chapter has explored in detail the aspects of cognitive bias in mega projects, firstly, it has established that cognitive bias is associated with the tendency to perceive information differently which consequently impacts the way a certain phenomenon is understood, often different from reality. Moreover, such a tendency has a huge impact on projects since decisions made are based on how decision makers perceive information. As a matter of fact, this demonstrates bias and prejudgement in making decisions, which often can have an overwhelming impact on the decision and choices made, as well as on the on the overall performance. Primarily, twelve types of cognitive biases have been identified and discussed at length in this chapter, and they include controllability, availability, anchoring, confirmation bias, cognitive dissonance, dread, familiarity, hindsight, scale, representative bias, optimism bias, and venturesomeness respectively. Each of this cognitive bias aspects have been contextualised to decision making process, and how potentially they can influence the nature of decisions that can be arrived at during different project contexts.

The chapter has also elaborated on the decision making processes by highlighting that there are different contexts, the main one ones being rational, intuitive, dependent and avoidant. Under rational-decision making process, there is a general characteristic of undertaking detailed consultations and inquiries, so that decisions made are based on facts and rationality. Further, it has been explained that intuitive decision making style is anchored on premonitions adoption, while dependent decision making style is founded on the premises of other parties' guidance in arriving at inferences. On avoidant style, the main characteristics is that the decision make often tends to avoid making decisions and does not therefore specific a course of action. The chapter has also discussed the decision making theories, an addition to decision making and risks associated in the context of mega projects, as well as potential costs. The next chapter will discuss in details the conceptual framework model that guided this study, with an effort of demonstrating the association between mega projects and decision making based on cognitive biases respectively.

# Chapter Four: Research Conceptual Framework

## *4.1 Introduction*

The conceptual framework presented in the on-going section is meant to align the discourse with the broader field of research on cognitive bias and decision making. Precisely, the hypotheses, research variables, and underlying relationships of the current discussion are weaved together according to the principles of research. Indeed, the discussion presented is built on an extensive review of literature on the constructs under investigation. As earlier discussed, a cognitive bias in decision-making is a concern of scholars in many fields of study. The construct has been investigated widely thus, allowing for synthesis into clear frameworks backed by theories and clear definitions. In line with the preceding comments, the conceptual framework presented in this section draws from multidisciplinary research. In addition to the conventional discussion of the interactions between the variables; this section also aims to align the methodology of the study with the idealized hypotheses. Ultimately, the discussion presents the thesis in the context of past and contemporary research on cognitive bias and decision making by attempting to justify the posed relationships and the methods used to investigate the constructs.

The constructs identified in this thesis are a cost overrun, decision making, personality traits, risk decision-making, and over-optimism. The aim is to resolve the relationships between the variables in view of commonly accepted principles in research. In addition, demographic characteristics of the sample under investigation are included to highlight the differences between different firms and how they conduct Megaprojects. The on-going investigation found that a multi-level approach of viewing the variables is most effective when investigating cognitive bias and decision making;

this is because the interactions are nested within each other; for instance, demographic characteristics, personality traits, and cost overrun are multilevel factors affecting over-optimism as later demonstrated in the analysis section. Methodologically, multilevel relationships where variables are not only linearly or non-linearly related but also nested within each other call for hierarchical regression techniques. Therefore, the following sections will present a topical synthesis of the research variables and their relationships in the context of other studies. Notably, even though the individual variables are discussed separately, the discussion blends the ideas into a simple and easily comprehensible model that can be relied on by future researchers.

Evidently, the discussion detailing the effect of different variables on decision making will be incomplete without the inclusion of factors that adequately quantify whether a project is successful or not. A similar study conducted by Bakhsheshi and Rashidi(2011) argued that the success of different projects depends on the innate characteristics of the project. Moreover, different project specifications may lead to unexpected classifications to what may be terminated as success or failure. For instance, a project may be termed as financially successful but fail to meet the expected goals of the investors and shareholders. Moreover, different parties involved in the execution of the project may ascribe different levels of success or failure. For instance, employees and stakeholders may feel a project is a failure due to the time and cost overrun, however, the expected utility of the project may outweigh the demerits. The above explanations serve to clarify that the definition of success or failure in projects is relative to the type of project and the sphere under investigation. In this conceptual framework, more emphasis is given on the definition of the variables and constructs under investigation more than whether a project is a success or a failure.

*4.2 The Conceptual Model/Framework*

The conceptual model is a diagrammatic representation of the envisaged variables under the study, comprising the independent, dependent and mediating or moderating variables as well as the theoretical dimensions that will make it easier for the researcher to demystify the study's objectives. These constructs are developed from the overall empirical review, researcher's understanding and interpretation of the specific objectives, and critical analysis of theories that can be applicable to the current research aim as below.

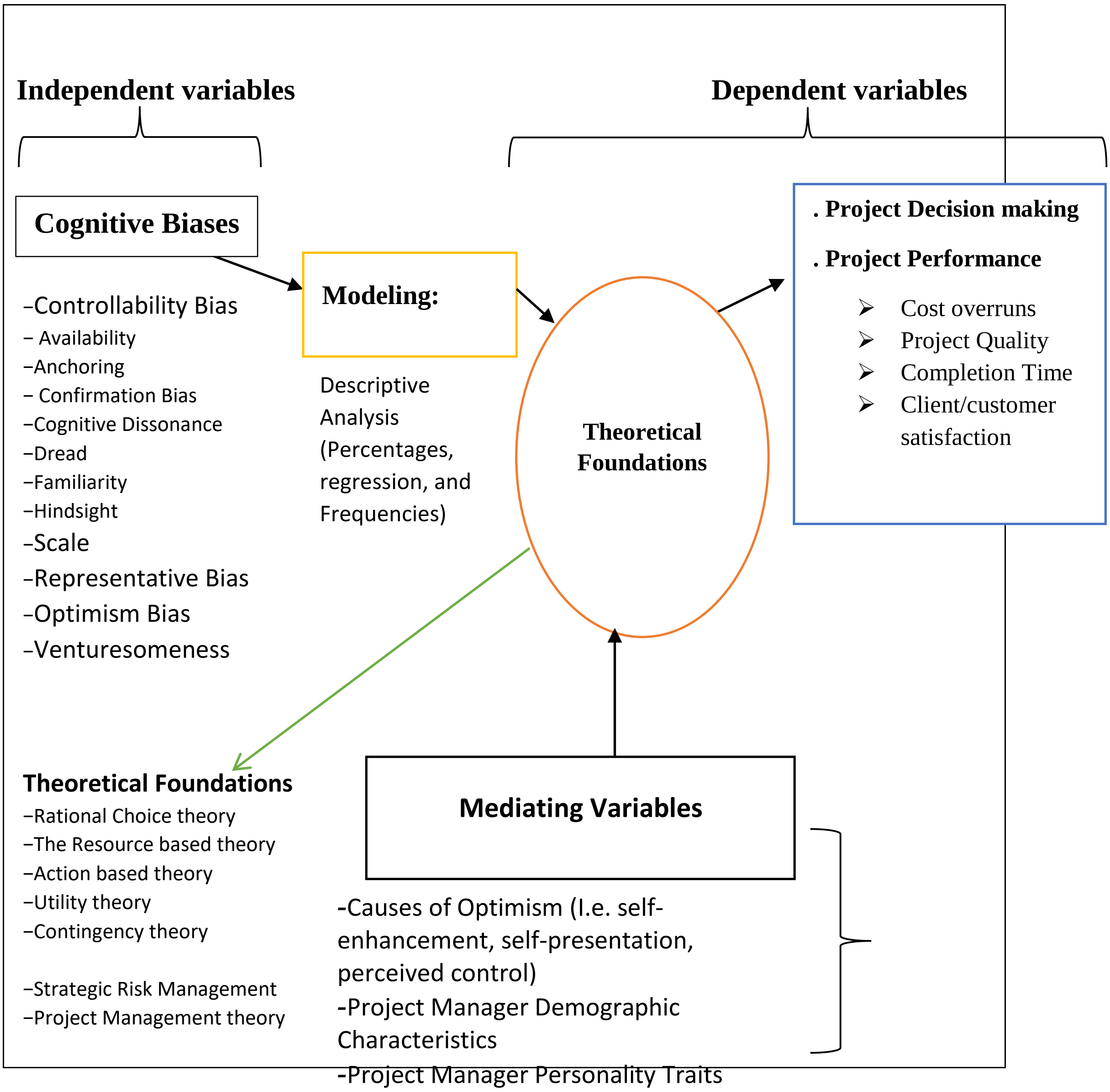

Figure 4.2: A Conceptual Framework

Source: (Author, 2020)

From the framework above, critical areas to be discussed include the different components of cognitive biases and how they can be linked to project decision making and performance as the dependent variables through mediating variables and theoretical foundations. Each of these variables and theoretical foundations will be discussed independently on how they are hypothesised to be related as presented in the sub-sections below. Therefore, it is important to note that the conceptual framework was developed from the researcher’s view and understanding of the materials that have been reviewed, right from the contextualisation of the study in background statement, to the empirical review as well as cognitive literature.

*4.2.1 Independent Variables*

From figure 4.1 above, the only independent variables in this study are cognitive biases, which are of different types. Each of the biases provided is hypothesised to have a causal effect on the nature of decisions made in mega projects, which ultimately affect project performance. Nonetheless, in each scenario, there is an understanding developed that some moderating or mediating variables have an impact, which will now be explained the extent to which such impact enhances project decision making and performance.

Firstly, controllability bias is one of the cognitive biases that have been identified in the ongoing discussion. Past research indicates that individuals with controllability bias are often inclined to believe that they have the ability to control the outcomes of imminent events due to their exposure with events in the past (Mentis, 2015). The view that forthcoming outcomes are predictable and controllable leads to major challenges in project completion (Mentis, 2015). Specifically, construction managers may fail to adequately acknowledge costs leading to unsuccessful projects. Controllability bias has been investigated widely in social research; thus, there exist different conceptualizations of how the construct is related to decision-making. For instance, Marsh (1998) claimed that the perceived control allows individuals to build motivation which is instrumental in decision making. In this investigation, the relationship between controllability bias and decision making is conceptualized within the sphere of other biases. From argument by Marsh (1998), controllability bias can be seen to assist decision making in a positive way. By contrast, another investigation by

Carr & Blettner (2010) posed that controllability bias has a negative influence on the financial outcomes of individuals. From the above points of view, this research opted to provide a detailed discussion of how the controllability bias is conceptualized in this study.

Therefore, while assuming the positive impact, the conceptual framework hypothesizes that such an attitude among the implementers of a project, might predict that there are positive outcomes at the end of the project, and hence be inspired to work towards ensuring that project goals are made. It simply implies that a positive thought will lead to positive decision making, which when put into action will yield positive results (Wang et al., 2019). Further, in situations where it is presumed that a project will likely fail, implementers become demotivated, and this bias affects their delivery in the overall output of a project. Of greater concern, is that leaders are likely to influence their followers, by instilling motivation and satisfaction which are important aspects towards ensuring project success. The conceptual framework demonstrate the researcher’s understanding that if such a bias is modeled against established theoretical underpinnings, then there is a higher likely hood that project decision making and performance will be impacted, either positively or negatively depending on the prevailing conditions. Important to note is that all this is influenced greatly by different mediating variables that act as the platform for the relationship to be established?

Evidently, the discussion does not pose a negative or positive relationship; instead, the arguments posed herein are aimed at justifying a relationship exists whether negative or positive. According to Marsh (1998), the controllability bias supposition is founded on three basic assumptions. Firstly, decision-making occurs in a constantly evolving environment in which the individuals interact with other variables such as expectations instead of an unvarying and haphazard manner (Marsh, 1998). Fundamentally, the preceding statement implies that the decisions of individuals are not only influenced by environmental factors but also impact the environment too. Consequently, the second assumption attempts to idealize how reality and individual perceptions are connected. Marsh (1998) suggests that reality is partially constructed by social perceptions of individuals.

In detail, the preceding statement implies that individuals shape reality through the actions and decisions they make within the environment. The final assumption aims to lay a foundation on the interactions between decision-making and the socially constructed reality. In essence, the third assumption poses that there exist both uncontrollable and controllable events in the environment in which individuals make decisions (Marsh, 1998). Marsh (1998) emphasized that the relationship is complex, thus, in this study; a multilevel connection is discussed in addition to the simplified model conceptualizing the links between the constructs being investigated. In such a situation, a need to see occasions as controllable would be profoundly practical. It turns out to be certain that a straightforward requirement for control would be served by a contorted view of reality as opposed to by a precise impression of the possibilities of perceived actions and their respective outcomes.

Thus, from the supposition that human social reality is a "constructive process," it can be implied that the knowledge that reality is to some extent controllable may lead to decisions that actually confirm the posed reality. In addition, in scenarios where causality is considered vague and where individuals can make risk-free decisions without major consequences, it is highly probable to observe diverse decisions made without fear of distinct errors as a result of one's discernment. One-sided decisions that mirror an inclination towards deciphering future occasions as under one's control is alluded to as a "controllability bias" (Marsh, 1998). A controllability predisposition rather clearly encourages individuals to address their issue for control, however; less clearly, it can likewise enable individuals to increase wanted results. Such an inclination causes individuals to meet their set goals or perceived outcomes by means of the effect of this predisposition on inspiration and activity.

A controllability bias infers that individuals' attributions for events will be uneven towards factors they will have specialist over, later on, their examinations as they reevaluate past events will be revolved around before long, controllable components, and their suppositions with respect to best in class events will reflect a craving for control (Marsh, 1998). The consequences of such a tendency are that individuals will act even more as frequently as could reasonably be expected, with progressively vital assurance and feasibility, and show increasingly unmistakable steadiness and versatility, in actuality. A controllability bias is especially obligated to happen when control needs are especially high, for example, in light of tolerating a negative outcome. Past research offers assistance for discrete bits of this process. In explicit, inspect and theorizing on the effects of attributions, counterfactual contemplations, and movement give some assistance to the controllability tendency hypothesis. Examples of statements that may infer to controllability among project leaders include but they are not limited to; I am having control on the information related to the project cost estimation, I use several strategies to minimize the risk of my cost decisions, I can make the cost estimations for different projects, and I can easily make predictions for the different events that might affect the overall cost performance of the project”.

The second factor on cognitive bias is availability, which is closely associated with sensitivity to personality traits. Researchers in behavioral finance have widely investigated the impact of availability bias on financial decisions. Specifically, Moradi, et al. (2013) argue that even though most finance theories are founded on the assumptions that investors make investment decisions based on access to full information and rational decision-making protocols, there is compelling evidence that the contrary is true. In fact, there is evidence that systematic errors manifesting themselves in the form of shortcuts significantly impact the decision-making capacities of investors. Further, Moradi, et al. (2013) asserted that there is a significant association between personality traits and availability bias. In the same light, the results of their study showed a significant connection between personality traits and conservatism bias (Moradi, et al., 2013); this is not included in the current investigation, however, personality is encompassed in the extensive review of cognitive bias. The existence of the connection between availability bias and personality dimensions as purported by Moradi, et al. (2013) where it is conceptualized in the modeling of the relationships between the constructs under investigation.

Availability bias is a tendency of human beings to think that things that come to the mind more readily are more representative than actually the case (Margaret Rouse, 2018). It results from a cognitive shortcut known as availability heuristic which is a reliance on the things that are immediately thought of when it’s time to make decisions or judgments (Margaret Rouse, 2018). In the context of this investigation, project managers may fall prey to availability bias when they are required to make decisions on cost overrun promptly with extensive information; instead, they rely on information that they can readily recall and that is available to them. In the end, the decisions may lead to worsening of the situation. Availability bias is not entirely a weakness; in fact, there are instances, that it is useful. However, in mega projects systematic errors arising from over-reliance of readily available information instead of full information may lead to challenges in meeting success requirements of megaprojects. The workings of availability bias are further, elaborated by Marx and Weber (2012) who state that the bias emanates from the rational actors' theory that proposes that any rational actor at the point of making a decision mainly relies on decisions most recent perceptions. The easier it is to recall the consequences of a particular action the easier it is to rely on the action to make an essential decision. Most people rely on the content of their recall or something that those consequences are perceived to be (Marx and Weber, 2012).

According to Margaret Rouse (2018), the availability bias is proximal to factors touching on the physical availability of the project leader. She states that project decisions are mostly affected by the physical availability of a project leader. Project leaders experienced in specific tasks make decisions depending on private experiences from their past. Where delegation of managerial duties is done, the person to whom the power is delegated to may have had recent occurrences in his life that determine the kind of decisions that they make. These decisions may end up conflicting with the previous decisions of the manager delegating the managerial power. Some of the statements by project leaders which indicate availability bias include but are not limited to: I believe things that come to mind easily are an actual representation of the actual situation; I use several strategies to over-rely on readily available information; Information that is easily perceptible or recalled is a more reliable ground for decision-making; and I use past information as a shortcut to make decisions about future scenarios (Chen, 2013). As a matter of fact, this independent construct indicates that it can potentially influence the nature of decisions made in project management, which consequently lead to a significant impact on the performance levels of projects (Max and Weber, 2012; Shermer, 2012).The third construct under the independent variable is the anchoring factor, which is founded on the tendency to predetermine a certain numerical value, and then working towards achieving such a value without considerations on numerous factors that keep on changing on the project's lifecycle (Montibeller and von Winterfeldt, 2015). Further, it has already been established from the preceding discussions that mega projects are complex in nature, which implies that they demand a very flexible way of managing them, right from implementation to execution. Nonetheless, when managers embrace anchoring bias, it implies that they are not able to appreciate project dynamics, leading to rigid decisions that can greatly influence project performance.

In addition to this fact, the fourth concern is confirmation bias, whose connection with personality traits is posed in this investigation. In specific, this investigation poses that individuals with different personality traits have different degrees of vulnerability to availability bias which eventually impacts their decision-making. In her study Long (2017) predicted that a relationship exists between personality traits and availability bias, leading to this study's conceptual framework which sought to undertaken an investigation to determine if a significant relationship exists. Confirmation bias is the product of the cognition theory which holds that confirmation bias is one of the kinds of cognitive biases which involves favouring or literally confirming a pre-existent belief. The theory holds that confirmation bias has an impact on our mode of information collection, interpretation and recalling Preston (2012). The theory assumes that some of the effects of confirmation biases on decision making have been points of discussion over time, yet this should not have been the case because there exist no loophole to be of contention (Sanderson, 2010).

According to the psychologist, the bias is well elaborate as it occurs only in a particular class of people mostly those who play a role in decision making. The proposers of the theory hold that the bias is designed in such a way that on conducting various demonstrations reached a conclusion that human beings tend to be in a look-out for information which will support the ideas that they already believe (Cherry, 2019). This kind of bias makes people who seek information to fail being objective in looking at different situations. As a matter of fact, the framework used in this study theoretically uphold that a confirmation bias can lead to positive or negative decisions, which is greatly influenced by theoretical underpinnings as will be discussed on the theoretical framework section.

It is also important to briefly explain the context of cognitive dissonance as presented in the conceptual framework. Cognitive dissonance is the state of having inconsistent thoughts, beliefs, or attitudes especially as relating to behavioural decisions and attitude change (Konow, 2000). Ideally, when two cognitions are inconsistent, they are said to be dissonant. Cognitive dissonance in relation to this study is the analysis of how behaviours and attitudes change and differ with time (Mlanis, 2012). In this case, the concept of cognitive dissonance is inseparable from personality traits. Cognitive dissonance is viewed as a constraint of satisfaction problem. The main concern of this with regards to human traits is the fact that human beings have the trait of satisfaction desire. Where a person has a desire problem then chances are that his attitude will change and even conflict with his behaviour (Thomas Shultz & Mark Lepper, 1996).

Other scholars view cognitive dissonance as the state of having thoughts, beliefs, or attitudes that are inconsistent and are in conflict. In most, cases, such thoughts are especially related to decisions of behaviour and change of attitude (Konow, 2000). Decision-making theory recognizes cognitive dissonance and the effects that it has on projects as it can have both a positive and negative impacts depending on the magnitude of the hypothesized conflict (Eduards, 1954). Different project leaders have different desires related to the sense of the satisfaction of a particular leader. Decisions made by a person mainly rely on the principles that the person subscribes too. This includes ideologies and theories that the person subscribes to. Cognitions may have a link with the decisions made. Principles determine the traits that one subscribes to. Therefore, the concept of cognitive dissonance can be used to elaborate the impact that will eventually be experienced by project managers in making decisions while managing complex and mega projects, and this should be traced to project performance.

Meshack (2016) interrogates how contemporary project leaders have found themselves in situations which their cognitions are not compatible, he goes ahead to give statistical information that 68% of leaders in project committees have conflicting cognitions that hinder the achievement of the projects as planned. Meshack (2016) further advises that unless project managers team up and extinguish the cognition differences existing between them, cognitive dissonance will never be eliminated. Shepher (2017) agreeing with Meshack (2016) notes that one of the most prominent manifestations of cognitive dissonance is the circumstance where a project leader acknowledges the effort of the staff engaged in the project but fails to appreciate the quality of the work done by the staff. This is a conflict of cognitions as the effort is recognized but the work is not, yet one gave rise to the other. Shepher (2014) proposes that project leaders need to be more hands-on when it comes to an expression of gratitude or satisfaction and dissatisfaction. As a result, the fundamental association demonstrated on the conceptual framework is that this bias cannot be separated with project decision making and performance. Examples of statements showing cognitive dissonance among project leaders include but it is not limited to: I am disturbed about the cost decisions that are contradictory to my beliefs; I usually get confused between my cost decisions and beliefs; I usually change my decisions according to my beliefs; and my mental anguish usually influences my value judgments and my cost decisions. Thus, it is important for this association to be investigated further if indeed it impacts decision making and project performance in general.

The other important factor according to the conceptual framework is dread bias that affects projects as viewed from the theory of the unknown fear which provides that generally, human beings fear what is likely to occur. The fear is founded on the reality that there are chances of occurrence of a positive outcome or a negative income. It is a presumption among people that the chances of occurrence of a negative outcome are higher than those of a positive outcome (Rabin, 2011). The theory holds that managers are subject to fears that emanate from the pressure mounted on them for the desire that the goals of the project be achieved. The bias is founded on the assumption that the chances of success or failure of a project are at a balance of 50%, for succeeding or not (Shefrin, 2007). This assumption has been contested on the ground that it fails to take into consideration that at times the project plan is well organized in such a way that it is highly probable that it will realize the goals of the project than it will not realize the goal. The assumption, however, operates to the effect that human beings are generally afraid of what is likely to happen.

According to Shultz & Lepper (1996), the bias is however constrained by the fact that it is designed to protect project managers from blame whenever they fail to meet the desired expectations with regard to project success. The dread bias seeks to justify the failure of project managers at decision making by providing a platform to cleanse themselves from blame based on the fact that certain spheres are unpredictable and unmanageable (Shultz & Lepper,1996). There are instances in which a particular element of a project fails while the other elements thrive. The question posed to managers is how one aspect fails and the other thrive under the same management with all aspects subjected to the same decision-making protocols, decision constraints, and decision execution. The dread bias applies in such a way that it defends managers by using the fears that are associated with the end result of a project. In this regard, this assumption can be investigated through a number of variables such as theoretical underpinnings and mediating variable to determine how it impacts project performance and decision making. The examples of statements of managers who are influenced by dread bias include but not limited to: I let the fear of failure to influence my decisions; uncertainty leads to fear and affects overall decision –making; and fears are beyond my personal control as a project manager.

Apart from dread, familiarity bias is yet another important element to be considered since it influences individuals' traits as opined by Chew et al. (2011). Recent investigations have shown that there is an association between genetic predisposition and vulnerability to familiarity bias (Chew, et al., 2011). In detail, Chew, et al. (2011) predicted that personality traits and familiarity bias are connected through innate features in related to anxiety and decision-making under risk. Evidently, from the above link elaborated by Chew et al. (2011), the connection between familiarity bias and personality traits predicted in this investigation is feasible and needs to be explored more. Ideally, familiarity bias is founded on assumptions that once violated make it difficult to justify the posed relationships. More definitively, bias assumes that factors affecting the realization of the goals of a dream remain constant in all similar projects Kahneman (2011). It assumes that experience in a particular field exposes a person to all possible challenges likely to concur in the field. Consequently, this provides the manager the capacity to avoid the occurrence of the particular challenges as well as formulate ways in which the project goals can be achieved without a cost overrun or any avenues through which the project success is measured. The overall understanding of familiarity bias as presented in the conceptual framework can be elaborated through individual demographic characteristics as will be discussed on the moderating variables.

While focusing on hindsight, the model demonstrates a potential influence on decision making and mega projects performance through the proposed mediating variables. As a matter of fact, Sadi, et al. (2011) discovered that personality traits of investors are directly associated with the systematic errors commonly attributed to hindsight bias. Sadi, et al. (2011) tested their hypothesis using traits such as neuroticism and conscientiousness. Sadi, et al. (2011) proposes that even though investors and managers are often thought to make rational decisions, their personality traits may predispose their hindsight bias which significantly models their decision. Notably, hindsight bias is underpinned in the theory of approach change which proposes that the approach and perception of various things by a person changes with time (Hugo, 2010). The assumption that the bias is premised on is that perception is the reason behind someone doing something in a particular way (Shepher, 2014). Projects succeed or fail with the perception that the various stakeholders in the project have towards the project.

Perception is what determines the quality of decisions that a person makes and the quality of the execution of the decisions made with regards to the project. Apparently, it fails to take into consideration that there are so many social factors that control the change of an approach which includes the level of motivation as well as the attitude of a person towards the project (Dean Shepher, 2014). These elements will be further explored to establish if the hypothesised association actually exists particularly on mega projects.

Another important element is scale bias which is generally referring to a group of biases, that work together to create a huge impact on the nature of decisions made in mega projects (Montibeller and von Winterfeldt, 2015). This will further be explored through the numerous theoretical and mediating variables suggested on the model. In addition, there is also another type of cognitive bias regarded as representative bias, which is founded on the premises of philosophical interpretations in which a certain issue is deemed to be dependent on another issue (Mlanis, 2012; Jackson, 2009). In this case, such an association impacts managers;' reasoning in the sense that if they attach the success or failure of a project to certain factors say economic conditions, the moment the economy deteriorates they automatically expect the projects to fail, leading to a decline in commitment to enhance better results. In addition, the conceptual framework suggests that optimism and venturesomeness which refer to positively wishing or thinking and willingness to take greater risks by venturing in areas which are little explored, will have a huge impact on project performance. Conceptualizing over-optimism in the face of risk and decision-making is still under review. Currently, Bracha and Brown(2010) claimed that the construct is not in agreement with conceptualizations where decision weights are viewed independently of payoffs. For instance, it is difficult to align the over-optimism to the prospect theory and the expected utility theory which are theories that infer independence of decision weights and payoffs. Even with the latter identified weakness, other models linking over-optimism to decision making have been introduced. In their study, Bracha and Brown (2010) proposed an affecting decision-making model where the process is viewed from a dual perspective; rational processes and emotional process. The aforementioned levels of reasoning allowed scholars to effectively explain how optimism manifests itself in decision making. The rational component is not affected by optimism as decisions in under this form of reasoning are made based on action. By contrast, the emotional processes of reasoning call for making decisions based on the individual's discernment of the risk. Therefore, the emotional component is susceptible to over optimism. Fundamentally, Bracha and Brown (2010) rely on concepts of game theory such as the Nash equilibrium to conclude that an individual decision is a result of the interplay between rational and emotional reasoning. Even though the model proposed by Bracha and Brown (2010) is adequate for the current investigation, it should be noted that it does not affect the formation of beliefs; in contrast, these are modelled by individual interests and what they want to believe in. However, although different elements of cognitive biases have been presented, it is important to also explore the mediating variables in the current study's conceptual framework.

### *4.2.2 Mediating Variables*

According to the conceptual framework (Fig.4.1), the hypothesised moderating variables include the causes of optimism, project manager's demographic characteristics, and project manager's personality traits respectively. The causes of optimism in this case include factors such as self-presentation, self-enhancement, and perceived control respectively (Meshack, 2016; Pyszczynski, 1993; Kafayat, 2014; Diehl, 2014). The impact of such factors is that they lead to an individual's overall expectations and motivations, which can either, be over-optimism or under-optimism (Sharon, 2012; Thomas, 2013; Brach and Brown, 2010; De Meza, 2017) as previously discussed. Demographic characteristics are defined as the socio-economic characteristics of a population expressed statistically (Dulewicz, 2008). The subject of demographic characteristics relates much with the personality traits of members of the society including project managers, Chief Executive Officers and other leaders (Dulewicz, 2008). Traits are determined by the society that one grows in as well as the socio-economic setup of the society that one is raised in. The human mind is designed in such a way that its perceptions and reactions towards several things are influenced by the way the society views or perceives it (Crawford, 2011). Education level goes hand in hand with skills. Skills are defined as the learned capacity to carry out specific tasks competences or the talents to do things. Various personality traits are determined by the skill that one possesses. Traits such as over-optimism which at many times result to the underestimation of the complexity or toughness of the project are usually as a result of lack of skill in the particular field resulting from low education levels (Crawford, 2011).

Education levels also at many times causes the characteristic of pessimism in individuals especially those people who possess a high degree of skill in the particular field (Turner, 2010). They tend to figure out all possible risks that are likely to occur in the course of the implementation of the project plan especially in instances where the project is novel. They may even end up discouraging those interested in the success of the program by constantly questioning the applicability of the project plan, the weaknesses of the plan, the challenges that the plan is likely to face and the high chances of the failure of the project (Turner, 2010).

Age is another demographic characteristic which has over time been regarded as a factor so crucial in the appointment or selection of project managers. Upon the constitution of a team of project leaders many people prefer people who are aged, and this can be argued to be the need of having more experienced leaders but the reality is that people of vast ages are preferred for the wisdom that they possess and for the quality of decisions that they make which assure the realization of the project as well as the avoidance of the occurrence of cost overrun (Turner, 2010). Nonetheless, this should not be interpreted to mean that young people cannot be wise in leading project success as this is a misconception that this study will seek to examine.

The relationship between demographic characteristics and projects specifically traits of project leaders and project cost overrun is so proximal that it cannot be overlooked. The upbringings of project leaders and their socio-economic characteristics have an effect on their personality traits which then impact either negatively on their deliverance of the mandates bestowed upon them. This may result in the achievement of the project at its estimated cost, cost lower than the estimated cost, cost overrun or even a failure of the project. In this regard, the current conceptual framework will seek to examine of demographic factors can in any way influence cognitive bias for project decision making and performance.

Another important mediating factor is project manager’s personality traits. For instance, interpersonal replication is a trait that is exhibited amongst leaders of various projects. This is the way a person’s character mutates over time to accommodate the views ideas and schools of thought of the people he relates with over time (Pyszczynski, 1993). Leaders of the projects interrelate with one another resulting in an interchange of characters and traits. The change of these traits leads to a change of attitudes as well and this leads to conflicting behaviours and traits. As a result, cognitive dissonance is a concept to be figured in this.

Internal conflicts at times affect the decision-making capacity of a person especially those persons mainly tasked with the role of making resolutions. This is because internal conflicts result in attitude change as well as behavioural change (Rabin, 1991). The way that a person is likely to address subordinates, peers, or even seniors result to change in the approach of decision making (Rabin, 1991). Further, perceptions of the resolution to be made also plays an important role in the traits, desired attitude and behaviours of the particular leader (Elliot, 1994). Where a project leader has been coerced to make a particular decision his attitude to the particular decision shall not be the same to that which he agreed to make the decision wilfully. In order to understand the impact of independent and mediating variables on mega projects, it is also important to contextualize the dependent variables of the study.

### *4.2.3 Dependent Variables*

According to the conceptual framework, the main dependent variables for the study are project decision making and performance respectively. The specific elements of project performance include cost overruns (project budgets), project quality, completion time and overall customer satisfaction. Focusing on cost overruns, it is conceptualised that managing megaprojects is troublesome because of incessant deception about the costs which results in huge cost overwhelms that frequently compromise the general undertaking practicality. It is valuable to recognize "causes" and "underlying drivers" in clarifying cost overruns advantage deficits, and deferrals in significant ventures. Attempting to work out the impact of the vast majority of these factors at the beginning phase of a venture when cost targets are set, can be a thorough errand, if not purposeless. There is additionally an abnormal state of vulnerability around a large portion of these components at the initial stages of the venture as verified by Jennings (2012). Consequently, the reasons for venture underperformance or cost overruns include but are not limited to: scope changes, demand deficit risk, mechanical vulnerability, unforeseen topographical highlights, venture intricacy, and negative majority power, for example, restricting partner voices. Most likely, these components at some time add to cost invades and advantage deficits, however, it might be contended that they are not the genuine, or root, source.

Cost overrun is among the major problems in Megaprojects. In the on-going thesis, cost overrun is a research variable that is related to decision making. In turn, cost overrun is known to be affected by personality traits and over-optimism as discussed in earlier sections; thus, the relationship between cost overrun and cognitive bias can be theorized through the interactions of the components influencing cognitive bias such as personality traits and over-optimism. Evidently, cost overrun models to a large extent the decisions of project managers; thus, the on-going section aims to elaborate on the interaction of the variables with each other. Cost overrun occurs when the actual cost of a project exceeds the budgeted, estimated, original, or target cost (Larsen, 2015). Bearing in mind its ambiguities and complexities cost overrun cannot be linked to a single source but several causes. Wroblewski (2018), states that there are various causes of project cost overrun all revolving around the managers' personality traits and decision-making processes. The reasons are given above clearly show that there is a relationship between cost overrun, personality traits and decision making. Notably, this research poses that personality traits influence projects managers ability to effectively manage cost overrun in Megaprojects. Thus, different personality traits may have an influence on one or more of the causes of cost overrun identified above.

As discussed above, cost overrun arises as a result of several variables; however, the focus of the on-going section is to determine how the construct affects decision making. The link between cost overrun and decision making can be understood by enlisting a clear definition of decision making. Wroblewski (2018) defined the decision making as the thought process of selecting a logical choice from the available options which include weighing positive and negatives of each option and consider all the alternatives. The person must also be able to forecast the outcome of each option or alternative and determine which option is the best for that particular situation (Wroblewski, 2018).

Over time scholars have noted that costs are frequently understated in the initial preparation for the execution of extensive projects (Flyvbjerg, et al., 2008). The underlying variables leading to underestimation of project costs is often attributed to psychological biases related to personality traits and the innate characteristics of megaprojects. Projects managers and the stakeholders involved in mega projects often play down costs due to optimism bias (Flyvbjerg, 2017); this happens when they underestimate costs and overstate the benefits of the project. Moreover, scholars claim that pessimism in megaprojects does not seem to reduce cost overrun as erroneous estimates are often magnified instead of cancelling each other out (Flyvbjerg, 2017). With regard to the characteristics of megaprojects, the supposed "uniqueness" of most major projects leads to the adoption of novel designs and limits the ability of managers, CEOs and other stakeholders to learn from other projects (Flyvbjerg, 2017).

Specifically, Flyvbjerg (2017) refers to the latterly described phenomenon as "uniqueness bias".

Projects experience overrun as a result of unrealistic cost estimates and inadequate funding. These are factors that are arrived at through the process of decision making. The managers and coordinators of a project brainstorm and come up with the project estimated cost which is an issue of decision making (Cantarelli, 2010). Where managers arrive at a decision grounded on wrong estimates then it is prudent enough that the project will experience overrun. Coordination and contingency plans are guaranteed where decision making is rational. Irrational decisions result in poor coordination and unachievable contingency plans. Resulting to an overrun since where coordination is poor there is loss of project funds and also where the contingency plan is not clear or unachievable more funds are used in procurement of services or even materials that are not necessary for the project.

Poor decision making process sometimes may lead to delays which potentially impact on project performance and cost overruns (Williams, 2010). Also, where leaders underestimate the toughness or complexity of a project, chances are high that they will allocate a small amount of money for the purpose of achieving the end result during their decision making process (Katongole, 2013). Later on, it becomes clear that the project is not as clear as it had been deemed to be necessitating the need of pumping more resources into the project in order to supplement the earlier given estimates leading to cost overrun. The variable of risk relates with a cost overrun in the sense that the framers of the project may fail to take into consideration the most probable risks that the project might encounter and the effects that the risk might pose on the project (Kazaz, 2012). The project then encounters risks that the framers did not have in mind that it would occur and at times finding the project uninsured against the particular risk thereby causing a loss that cannot be redressed by any other means apart from more funding by the project owners (Kazaz, 2012).

Confirmation is the other variable that relates with a cost overrun in the sense that at many times the project plan fails to conform to the realities of life and as a result, the whole plan ends up being just but a fiction which cannot be realized (Hole, 2011). The quality of decisions made can be inferred from the resultant effects once the particular action is taken (Love,2013). Among the effects of decisions made and actualized is the resultant cost of the particular project. Decisions, therefore, play a major role in the resultant cost of the projects. Key decisions such as the employees to carry out the project, the remuneration of the employees, the source or supplier of the project requirements and the cost of procurement of the project requirements have an impact on the eventual cost of the project (Love, 2013). Cost overrun is as a result of poor decision making that result in decisions which do not take into consideration the cheap alternative options existing. In his study, Shepher (2014) argues that project managers should come up with decisions which strike a balance between cost and quality because both can result to a cost overrun in one way or the other. Further, Love (2013) argues that individuals have a tendency to hike prices with an aim to create the impression that the products are of high quality, in essence, they capitalize on biases such as anchoring where individuals use a specific feature to make judgments on every occasion.  Meshack (2016) further argues that in pursuit to curb the chances of an occurrence of a cost overrun project managers should learn to strike a balance between quality products and low-cost products.

Shepher (2014) states that decisions of project managers are usually designed to curb cost overrun therefore mainly they seek to procure cheap products and services so as to spend little, however, this places the project at a high risk of a cost overrun since the durability of the cheap products is not guaranteed. Love (2013) goes ahead to state that projects should mainly focus more on quality than spending little or else that project will end up spending more than what was budgeted for. Pearce (2013) states that decisions made should be those that are meant to ensure that a project of the desired quality is achieved because where decisions are designed to curb cost overrun then the quality of the project shall be ignored. Projects fail for lack of synchronization of the quality and the desired outcomes (Hugo, 2010).The relationship between cost overrun and decision making is also looked from the angle of the perception of the project managers to the project (Hugo, 2010). The complexity of a project is an essential factor in attempting to curb the occurrence of a cost overrun. Project costs are products of an estimation which relies much on the perceived complexity of the project (Hugo, 2010). Where the complexity is underestimated the cost estimate will be underestimated to and eventually completing the project with the estimated value will be impossible resulting in a cost overrun. This is also affirmed by Hillary (2013) who states that the complexity and cost of a project are directly proportional. Decision making also may result to cost overrun in the sense that project managers make judgments that do not take into consideration the fluctuations in prices of services and materials in the market (Berechman, 2011). The market where products and services are sourced is dynamic and changes within a short period of time. Project managers are therefore required to have in mind the chances of hiking of prices of services and projects in the market where they are sourced from (Berechman, 2011). The managers are therefore expected to come up with prices that will not be rendered too low once the prices hike as a result of economic fluctuations.

Statistics proved that framers of unsolicited project plans fail to take into consideration the high chances of occurrence of fluctuation for the fear that the plans may be rejected for lack of reasonability. Approximately 25% of such projects fail as the result of a cost overrun which at times is as high as 33% of the estimated cost of the project (Berechman, 2011). In explaining this statistical data Jackson (2009) states that it is for the lack of considering fluctuations that would occur in the economy because most organizations and corporations compare project cost estimates with the contemporary prices, therefore, choose projects plans that are within the scope of the contemporary prices (Jackson,2009). Placing the fear of being left out by firms seeking to undertake a project as a result of the competition from other firms, therefore, firms decide to under-quote the prices so as to win the particular project (Jackson, 2009). Decision making in solicited project plans is different from that in the unsolicited project plan. This is because as the former is oriented and motivated on the achievement of the project, the latter is motivated by beating the existing competitions (Jackson, 2009). Cantarelli (2010) states that the duty of disclosure of all material information bestowed on the project planners is usually violated in cases where the project is unsolicited. This explains why decision making in unsolicited projects is impaired and mostly results in decisions that give rise to cost overrun (Cantarelli, 2010). In addition, this leads to lack of client satisfaction given that such projects are eventually completed at higher budgets than initially planned for, they take longer time than planned for, and may end up being of poor quality. Ideally, these are the performance indicators conceptualised in this study’s framework to indicate how the process of decision making is impaired by a number of constraints, leading to poor project performance. Further, in expounding on the associations that have been explained on the conceptual framework, it is important to review the theories that have been proposed to shape the impact of cognitive biases on project decisions and performance.

*4.2.4 Theoretical Framework*

There are a number of theories which have been linked to the current study and conceptualisation and they include; rational choice theory, the resource based theory, action based theory, utility theory, contingency theory of leadership, strategic risks management theory, and project competency theory respectively.

*Rational Choice Theory*

The theory outlines that rational considerations are used by individuals to make rational decisions, for the attainment of the anticipated personal goals. Based on the theory, the development of rational choices is expected to result in positive outcomes that provide individuals with diverse benefits and satisfaction (Archer and Tritter, 2013). The theory anticipates that the benefits attained from an interaction whether social or economic, outweigh the costs (Eriksson, 2011). Rationale choice theory operates on three major assumptions namely; individuals act in rationale ways for their own self-interest rather than that of others; every human being has sufficient information upon which they develop their preferences as well as conduct their rational analysis; and that preferences are transitive (Archer and Tritter, 2013). Moreover, in relation to the interactions that are international in nature, the theory highlights that the conduct of international bodies such as governments and NGOs is best understood by analysing the conduct of the individuals that manage them and that aggregate decisions made by each decision maker determines the overall success of the organizations

(Archer and Tritter, 2013). Critics of the rational choice theory have however argued that individuals are not always able to gather all the information needed in the development of rationale choices. Moreover, there also exist instances where rational decisions are made but not necessarily for the realization of utility gains (Eriksson, 2011).

Founded on the theory above, it is evident that the nature of choices made by decision makers in mega projects is fundamental for the realization of successful project performance. In the event that project managers in mega projects make decisions based on their self- interest as the first assumption highlights, there is a high likelihood for the development of cognitive dissonance. In particular, when project managers are concerned about their self-enhancement and presentation, there is a high probability that the decisions that they make will be conflicting with the beliefs and attitudes of other project managers. Consequently, there is a high likelihood of low project performance since all the project managers are not oriented towards the realization of successful project completion. Moreover, the assumption that every individual has adequate information to aid in rational analysis depicts that project managers are assumed to have enough knowledge and information to make critical decisions in mega projects. The reliance of project managers as key decisions makers without the inclusion of inclusion is likely to contribute to the development of familiarity bias. Precisely, project managers are likely to base their decisions on familiar mega projects, which increases project risk and the likelihood of cost overruns since the monetary value of projects will be based on underlying worth. The use of such experts as financial advisors is thus necessary in mentoring the effects of anchoring type of bias. Lastly, since the success of mega projects is dependent on the amassed decisions that are made by project managers, the joint establishment of decisions by project managers is vital for the reduction of such biases as optimism and availability bias.

*The Resource Based Theory*

The theory contends that an organization is able to obtain competitive advantage over its competitors by owning resources that are strategic in nature. In regard to the theory, strategic resources aid in increasing the competitive advantage of an organizations (Marvel, 2012). The four major characteristics of strategic resources include the fact that they are; valuable, rare, difficult to imitate and non-substitutable (Selznick, 2011). Valuable resources are recognized as those that enhance the effectiveness of an organization as well as neutralize the opportunities for competitors. Further, when resources are possessed by few or no competitors are recognized as rare (Wojciechowska, 2016). On the other hand, those resources that are usually protected in a legal manner such as trade -marks as well as those that are developed over time are classified as being difficult to imitate (Wojciechowska, 2016). Moreover, resources are collectively described as non-substitutable when they cannot be duplicated by competitors (Marvel, 2012). As a result, it is vital to bundle resources together such that it is difficult for competitors to duplicate them.

The resource based theory shows the significance of critical evaluation of resources for the realization of project success. Project managers in mega projects in collaboration with their subordinates require evaluating the resources that are needed from the initiation to the completion phase of projects. Analysis of the resources that are needed in projects will aid mitigating availability, anchoring and optimism bias respectively. On one hand, rather than making the assumption that a given resource is suitable since similar projects have used the resource in the past, project managers in conjunction with experts will be able to evaluate the most suitable strategic resource to use based on the available options. As a result, there will be elimination of availability bias. On the other hand, evaluation of resources will aid in the reduction of cost overruns. Precisely, cost experts will support project managers in the identification of anchoring bias by noting the distinctions between the estimated prices of resources and the actual prices. Moreover, a suitable scale of managing the utilization of resources in mega projects will also be developed further contributing to the reduction of cost overruns that emerge from inefficient utilization of project resources. Lastly, since most project managers are easily influenced by optimism bias while making decision concerning mega projects, they are likely to be confident that the supply of resources during the implementation of the project will be adequate. It is thus significant for a resource evaluation to be conducted to ascertain the future supply of resources. Moreover, it will also aid in the elimination of any dreads that a mega project may fail due to inadequate resources.

*Action Based Theory*

Based on the theory, actions are described as the conduct that is triggered by an individual in a given context. Desires as well as beliefs are recognized as being vital in the development of the behaviour that is portrayed by individuals (Sassenberg and Vliek, 2019). Both belief and desire are identified to jointly contribute to action. Individuals thus endeavour to carry out actions that satisfy their innate desires (King and Zannetti, 2013). Additionally, the theory looks at rationality from two perspectives. On one hand, it is described as the approach of determining the best technique to be applied in the attainment of one's goals while on the other hand it is the act of responding to the aspects perceived by an individual rather than just focusing on the wants (Sassenberg and Vliek, 2019). Some scholars have however argued that there lacks a consensus of the actual definition of actions and whether some activities such as thinking are recognized as actions (King and Zannetti, 2013). Additionally, there also exist controversies on the causal factors that prompt individuals to portray several actions (Sassenberg and Vliek, 2019). .

In reference to the action based theory, the beliefs and desires of project managers are major influencers of the actions that they will undertake which consequently influence the success of projects. Cognitive dissonance is likely to emerge in the situation that project managers have diverse desires as well as beliefs. Particularly, in the case where the beliefs, attitudes and conduct of project managers are divergent, there is lack of a common ground for the establishment of project decisions which in return negatively affects project performance. Whilst project managers may possess distinct desires and beliefs, it is vital for them to be jointly embrace rationality by identifying the most suitable approach of executing the project as well looking in to the ideas raised by their counterparts rather than just focusing on their wants. Harmonization of ideas will aid in the realization of quality mega projects that are completed with thin the stipulated timelines and based on the customer’s needs.

*Utility Theory*

The theory highlights that the behaviours as well as choices that the made by individuals are based on their individual preferences. The theory employs a utility function that helps to rank individuals’ preferences founded on the gratification that emanate from fulfilling the wants (Chipman, 2014). Utility theory is founded on four major assumptions namely; completeness property of preferences more is better, rationality and mix is better. Based on the first assumption on completeness property of preferences, individuals are able to rank their wants based on the level of satisfaction that they are likely to obtain after fulfilling the wants (Edwards, 2013). The characteristic where individuals are able to categorize their wants founded on the individual wants is termed as completeness property of preferences. The more is better property on the other hand argues that despite individuals being able to fulfil their preferences, they will still want more since no cost is incurred when disposing want is in excess (Chipman, 2014). On the other hand, the third assumption of mix is better highlights that in the event where an individual is not able to decide to decide on the preferences that they need to fulfil first, it is better to partially fulfilling each of the preferences rather than either one of them (Edwards, 2013). The last assumption on rationality on the other hand indicates that the ordering of individual preferences based on ranks is always fixes irrespective of time or even context (Edwards, 2013).

Utility theory highlights the importance of making choices based on their order of preference. In a similar manner such demographic characteristics of project managers such as the level of experience are expected to direct to identify the choices that need to be fulfilled first when conducting mega projects. Through the experience gained over time, project managers are able to rank the needs of mega projects based on their urgency, which consequently results to the completion of projects with the required timeline. Moreover, the more is better and mix is better principles of the utility theory is vital to project managers in mega projects in that they shows the significance of combining diverse ideologies in the decision making process. Specifically, when managers involve other experienced personnel in the development of decisions, there is a high likelihood of the eradication of project risk since there are lower instances of recalling of similar issues which leads to availability bias.

*Contingency Theory of Leadership*

The theory advocates that the effectiveness of leadership is dependent on the extent in which the leadership approach is in line with the situation. As a result, there is no single style of leadership that is recognized as being the best (Mcgrath and Bates, 2013). Contingency theory advocates the need to match an individual's style of leadership with a situation that is compatible. The least Preferred Co-worker (LPC) Scale is recognized as the most suitable scale of recognizing the leadership style of an individual (Willy, 2012). A high LPC score shows that a leader is people-oriented and focuses on the nature on the nature of relationships with other individuals while a low LPC score demonstrates that a leader gives attention to the execution of tasks (Mcgrath and Bates, 2013). Moreover, three key factors are used in the identification of the ideal situation for a leader namely; leader-member relation, task structure and positional power (Willy, 2012). In general, using the LPC scale in combination with the analysis of individual's leader- member relation, task structure and positional power to identify an individual's leadership style will aid in placing individuals in the right working capacities, which consequently leads to project success(Mcgrath and Bates, 2013).

Contingency theory depicts that there is no single style of leadership that is required for the successful completion of mega projects and that the most vital aspect is to match individual's demographics and traits with the project that is moat suitable to them. Specifically, when the project managers who are selected to oversee mega projects have the right demographic characteristics such as experience, there are better equipped to make enhanced decisions since their decisions will be minimally influenced by such cognitive biases as optimism and anchoring. On the other hand, it employing both task-oriented and people-oriented project managers in mega projects will facilitate in ensuring that the decisions in the process of project execution do not only focus on the project itself but also the relationships of the human personnel involved. Human resources are the key determinants of the extent in which mega projects are completed in time and with the anticipated quality.

*Strategic Risk Management Theory*

The theory proposed by Miller in 1992 postulates that there are five ways of managing the uncertainties that are likely to occur in the future. Uncertainty avoidance is recognized as the first strategy of avoiding risk (Taylor, 2014). In entails the recognition of the risks that are likely to occur in the future and refraining from being affected by the risk. Control of environmental contingencies is recognized as the second approach which entails controlling of environmental aspects such as political actions (Andersen and Sax, 2020). Cooperative responses on the other hand entail the collaboration of different organizations as a means of eliminating uncertainties. It results to the creation of joint ventures as well as the reduction of company autonomy. Imitation as the fourth strategy of strategic risk management theory entails the mimicking the strategies set by other organizations for purposes of company survival (Hopkin, 2013). Flexibility is recognized as the last approach which entails the enhancement of the internal responsiveness of an organization though the development of strategic decisions that focuses on reducing uncertainties (Hopkin, 2013).

Risk management theory highlights the significance of avoiding future uncertainties while undertaking future projects, to increase the chances of successful project completion. Founded on the theory, project managers who are venturesome in nature need to be cautious while tasking tasks during the project implementation phase. Whilst pursuing risks may be advantageous in some cases, it may also pose a great threat to project performance since negative uncertainties cripple down projects. As a result, venturesome project manages in mega projects need to frequently consult before pursuing any risk, in order to reduce venturesomeness, which is one of the forms of cognitive bias. Moreover, consultation with suitable personnel will also contribute in the reduction of optimism bias, which easily emanates from venturesomeness. On the other hand, project managers need to exercise flexibility while conducting mega projects. Flexibility entails the establishment of strategic decisions as well as their alternatives in the event of uncertainties. Establishment of strategic decision will enhance quality completion of mega projects within the stipulated time since uncertainties will be managed.

*Project Management Competency Theory*

Competency theory was developed in 1980 by Henry Gantt and Henry Fayol and focused on the characteristics of leaders such as project managers that contributed to the realization of superior performance (Morris and Pinto, 2010). The theory highlights that a combination of strategic leadership and right resources aided in the successful implementation of project plans within the stipulated standards (Nicholas and Steyn, 2010). Some of the mechanisms that the theory suggests that project leaders needed to adopt include; planning in advance, motivating team members and the provision of a conducive work environment where individuals would be able to effectively execute their roles. Despite gaining a lot of support from scholars, critics of the theory have argued that the theory has not been able to exhaustively focus on the process of project execution (Curlee and Gordon, 2010).

Project management theory shows that project managers in mega projects should employ such strategies as prior planning and team motivation for the realization of successful project performance. Prior planning will help in the elimination of controllability bias since project managers will be able to develop a work plan, which stipulates the duties and responsibilities of all the personnel that will be involved in the execution of the project. Moreover, planning in advance helps project managers to develop suitable monitoring and assessment tools thus lowering the impact of scale type of cognitive bias. Further, it is vital for project leaders to be people oriented and to focus on the welfare of their team members through the establishment of an environment that favours communication and creativity. Communication will allow team members to highlight the strengths and weaknesses of the process of project execution as well as give proposals on possible approaches of enhancing the quality of the projects. Favouring creativity in the process of project execution will also encourage team members to come up with innovative techniques of either executing the project on time or improving customers' satisfaction. Project Managers' personality traits thus contribute in the elimination of such cognitive biases as controllability, scale and optimism, which lead to enhanced project success.

#### *4.2.5 Application to Research Problem*

The conceptual framework developed is applicable to the research's main problem as it helps to answer pertinent issues raised in the introductory chapter. For instance, this framework clearly articulates the dominant trend which is observed globally where cost overruns are leading to project postponing and even halting of very important projects leading to more problems in the society as opposed to remedies (Siemiatycki, 2015). Nonetheless, in examining the relevance of the model to the current study, it is important to contextualise it using a multilevel approach to demonstrate the interplay between cognitive biases and personality traits. From the developed model, it is elucidated clearly that personality traits play a role in modelling the behaviours and decisions of key stakeholders involved in mega projects. A number of studies have linked decision making and personality traits through risk involved in project management. In specific, Lauriola and Levin (2001) tied personality traits such as neuroticism to risk-taking in decision making. In the on-going investigation, a multilevel relationship between personality traits and risky decision making is hypothesized. More definitively, cost overrun, and personality traits act as the first level influenced by risk as an extraneous variable. Notably, the interplay between personality traits and decision making is often analysed in the context of demographic characteristics of the study participants as demonstrated in Lauriola and Levine's (2001) study where they claimed that demographic details and different personality traits had diverse effects on the tendency of an individual to respond to losses and gains, thus, impact their overall decision making in the face of risk.

The resolution to attribute the bias leading to cost overrun to personality traits is motivated by research proven theorization of how the brain works. Firstly, Fujino, et al. (2016) observed that certain types of individuals were more prone to make erroneous cost decisions. People with such personality traits often find themselves undertaking projects with poor expected benefits at extremely high costs. This thesis isolated 12 personality traits to map people with different expected behaviors when faced by decisions in mega projects. While other studies test a limited number of key personality traits, this research adopted a more detailed approach to allow a comprehensive analysis of the variables. The individual personality traits and how they affect cost overrun are discussed below. Even though the analysis is given independently of the entire conceptual framework, the ultimate aim is to link personality types to cost overrun and their interplay with decision making.

Notably, the current study identified a multilevel variable that may influence personality type and decision making. The relationship is complex; thus, the current investigation has simplified it. Statistical tests will be applied to determine whether there is a significant relationship between any of the 12 identified cognitive types. Even though other studies focus on different cognitive traits, the selection of 12 included in this study is meant to ensure inclusivity of different types of individuals in the analysis. Moreover, the traits are linked to common cognitive biases such as over-optimism and the more common self-serving bias where individuals have the tendency to see the worst in others. According to researchers, self-serving bias helps in protecting an individual's self-esteem; however, it leads to faulty decisions since the person making the decision will reach a conclusion without considering all the factors that might have contributed to the outcome (Cherry, 2019). It has been widely observed that several factors influence this bias. They include even gender and age. Those of the old age are more likely to attribute success to themselves. On the other hand, men tend to believe that the most successful things that happen in their households are attributable to them (Cherry, 2019).

Nevertheless, decision making in individuals is often affected by cognitive bias that arises as a result of numerous factors. In his study, Hilbert (2012) proposed viewing the interaction between decision-making and cognitive bias using a unified framework composed of propagative techniques that are perpetuated by underlying clamor in the interactions between memory and information processing algorithms in the brain. According to the researcher, the interactions are typically involved in making subjective estimates from objective information fed into the brain; thus, they are prone to cognitive bias (Hilbert, 2012). Specifically, Hilbert (2012) identified eight decision-making predispositions that can occur as a result of the interaction between memory and information. For instance, confidence bias and exaggerated expectations which hold similar weight as over optimism in the ongoing study have been identified by Hilbert (2012) as among the eight empirically verifiable biases.

While the impact of cognitive bias on decision-making in Megaprojects is often viewed as detrimental to the success of projects, other scholars offer alternative conceptualizations that ought to be factored in the current framework to effectively model the current research problem. Dominic, et al. (2013), hypothesized that cognitive biases may be beneficial to decision making as they present themselves as adaptive processes. More definitively, Dominic et al. (2013) posed that when cognitive biases are viewed in the context of evolutionary development and innate limitations of the human mind they can be seen as beneficial. Even the view suggested by Dominic et al. (2013) is outside the scope of the current investigation, its incorporation into the discussion helps to ensure that the relationship between decision making and cognitive bias is exhaustively discussed. Moreover, understanding the different sides of cognitive bias can help to address discrepancies commonly observed in empirical analysis and statistical tests investigating the constructs. Essentially, the preceding discussion helps to highlight that the cognitive biased investigated in the current thesis have the potential to affect decision making in diverse ways depending on the context. For instance, cognitive biases may manifest differently when managers and CEOs are faced by increasing costs of conducting megaprojects in comparison to when a project is begun when optimism is still high.

For the technical factors causing cost overrun, many of the factors can be forecasted and managed, and it is expected that the preparation of project expenses and the duration to advance with time since experiences come in handy to the project coordinators though no improvement has been observed in the whole century and it could be attributed to the trend seen in underrating the expenses and period of projects specifying that mega projects are highly exposed to surpass the resources and duration defined (Siemiatycki, 2015).The concept of strategic misrepresentation as one of the factors causing project overruns can be traced to two theories; agency theory and the theory of strategic deception (Gbahabo and Ajuwon, 2017).

In Flyvbjerg, Skamris and Buhl (2004) study, the scholars interpreted agency difficulties to occur when a connected link of intercessors exist at each section of the implementation of the project among the project's funders who are mostly the public through tax paying and other stakeholders who manage the project such as project organizers, marketers and service providers, project management experts, public representatives, and organizations, among others. More, the academicians proposed that deception and misrepresentation happen as a result of numerous views that include the manifestation of information unevenness, self-centeredness, and the handling of project risk (Gbahabo and Ajuwon, 2017). By applying the concept of strategic misrepresentation, it is clear that project organizers forge the expenditures and period for the project to make certain the project is authorized so as to safeguard their egocentric interests in benefiting monetary wise, workwise, or in the political arena (Siemiatycki, 2015).

The study is founded on the notion from recent research by Flyvbjerg (2018) who concluded that cost overrun is majorly elucidated by the psychological biases portrayed by the project stakeholders to purposely underrate expenses and overrate outcomes to have the project authorized for implementation implying a causative connection from strategic misrepresentation to cost overrun. The study expounds on the effect of the psychological biases, in this study referred to as cognitive biases, on cost overrun and since cost overrun in this study is attributed to mainly over optimism, then the study looks at the influence of cognitive biases on cost overruns due to over optimism in mega projects. Since cognitive biases are the main elements causing strategic misrepresentation through decision making, the cognitive biases effect on decision making and cost overrun leads to the interest in this study's focus. Further, in this study, the project stakeholders scrutinized are project leaders who are involved in decision making therefore have direct control of influencing project's direction and include engineers, project managers, directors, CEO's and where others represent persons who are decision makers but are among the ones listed who actively contribute to the project's implementation.

Flybjerg (2013) demystifies the relationship between decision making and over optimism in doing this he creates the difference between over optimism and personality traits by stating that over optimism is not in any way a personality trait. (Flybjerg, 2013) argues that over optimism is usually as a result of the cognitions resulting from the too much positivity. Flybjerg (2013) clarifies this by arguing that positivity or negativity is not a personality trait but a characteristic bound to vary with the prevailing conditions. Managerial over optimism does not exist, what exists is a managerial underestimation of the project and managerial overestimation of the capacities of the organization undertaking the project (Hillary, 2013). Thus, Hillary (2013) adopts a dual perspective in discussing the subject of over optimism. Over-optimism results from the underestimation of the complexity of the project which results from failure to take into consideration the actual complexity of the project (Hugo, 2010), which could be due to lack of experience or equating the project to another project with several differences and a few similarities or vice versa.

Decisions are therefore made in such a way that the possible challenges that the project is likely to face are not factored. Hillary (2013) states that statistics prove that over 60% of projects suffer from obvious challenges that the managers had not had in mind yet is so open that any reasonable man would not have failed to accommodate them. The way that projects fail in the hands of unqualified and inexperienced managers and directors (Hugo, 2010), is the same way that projects fail in the hands of qualified managers who out of the experience and over optimism tend to believe that everything is achievable even with a careless approach (Hugo, 2010). The second perspective upon which over optimism occurs is in cases where the managers overestimate the capacity or ability of the organization undertaking the project in so far as the project is concerned (Flybjerg, 2013). Managers tend to believe that the organization can deliver everything mostly as a result of previous successes and accomplishments that the organization has had over time. The organization then undertakes a project that it has not planned for this possesses challenges, not within the scope of solving by the group (Cantarelli, 2010). Hugo (2010) argues that decisions made are usually subject to variation with the expertise of the organization undertaking the project. Where the managers and other leaders overestimate the expertise and ability of the organization, the decisions that the managers come up with overlook the loopholes existing in the structure of the organization that would inhibit the achievement of the goal of the project (Pearce, 2013).

Hillary (2013) states that, the subject of over optimism has drawn the interest of various scholars because of the statistics available on it. In a study conducted in 2012 it was revealed that 70% of the companies under study had their managers not sure of the abilities and inabilities of the companies they were serving in (Meshack, 2016). 5% of the remaining did not know what the companies they were working under could not do as they believed that their companies could achieve anything that it desired (Meshack, 2016). Further, Meshack (2016) States that, not unless managers of projects get to understand the abilities of their companies and cure the over optimism that impairs decisions that are capable of not achieving the dreams of the company at the time of the configuration of the project. Meshack (2016) agrees with Love (2013) who claimed that decision making and over optimism affects projects grossly and determines the chances of achievement or failure of the project. Flybjerg (2013) suggests that personality traits, on the other hand, influence the quality of decisions made by a manager and the influence that the decisions have on the project. Flybjerg (2013) further attributes personality traits to be a source of the different decisions that different people make saying that decisions vary from one person to another just like how personality traits differ from one person to another.

Meshack (2016) states that personality traits have two effects on decisions which can either be positive effects or negative effects. Further, Meshack (2016) argues that every manager possesses personality traits that can give rise to decisions with positive effects and with negative effects it all depends with the trait directly involved with the decision to be made. In elaborating this, Meshack (2016) argues that this is the reason why project management teams are usually composed of more than one person this is because the personality traits shall blend along and come up with a more refined decision bearing both positive and negative effects. The question that arises in this is whether the blending of traits is achievable in circumstances where decisions are made with a vote by the majority since the resolutions and contributions of the minorities are left out (Meshack, 2016).

Positive effects mainly arise where the decision relies on a trait of positivity such as humility and knowledgeability these decisions are regarded to be more contemplated and a more refined decision arrived at (Pearce, 2013). On the other hand, Berechman (2011) argues that a decision has a positive effect on the project only if it links the decision maker directly to the project such as having the project named after the person making the project bearing the fact that people find pleasure in being attributed to the right to paternity (Meshack, 2016). Negative effects are on the other hand as a result of decisions made with a nexus to the negative traits such as greed and anger among the makers of the decision. Love (2013), claims that the study conducted in 2012 showed that 23% of the projects understand had suffered negatively from decisions made by managers who were not motivated and as a result make decisions as a revenge of as a punishment to the organization undertaking the project. Further, Pearce (2013) states that projects depend more on the trait of the people making their decisions than those implementing the decisions.

One may wonder how cognitive bias, risk, and cost overrun are related to each other. From the foregoing, it is appreciable that cognitive bias has an impact in both handling of risk and in the extent of overrun in megaprojects. With regards to risk management, much has been written concerning risk and the analytical methods that can be used in measuring risk. However, there is an urgency to increase and speed risk mitigation. There is a widespread failure in the programs laid down for risk management or mitigation, probably due to the fact that most drivers such as cognitive biases and motivation are often overlooked (Siefert, 2007). Addressing the question of cognitive biases is rarely done. This follows that most of the engineers claim not to have any biases in coming up with the risk management mechanisms. Their argument is that they only use reasoning, logic, and math in arriving at their decisions (Siefert, 2007). As per the analysis of the data that was collected by Seifert (2007), cognitive biases are confirmed to have a significant impact on risk management or mitigation. It, therefore, follows that a better and sufficient knowledge of the cognitive biases is a means to better risk management.

Studies by Bahill et al. (2007) and Smith (2006) show that people always have the tendency of being overconfident on their ability to handle and solve sophisticated issues, even when the actuality proves otherwise. It is important to understand that risk management and trade study have much in similarity than the differences. As such, to reach a better solution, risk management will require a similar approach used. There are several biases in the field of risk management, including overconfidence, aversion to ambiguity in any situation, training in an area of expertise and life experiences. Notably, as much as the list is not exhaustive, the biases are not unique to any person or situation; they are common. Thomas (2007) observed that there is a susceptibility of biases in every project and even in every individual that takes part in the project. They are very common in the area of risk management following the prejudices that people have as regards how they can solve the problems that they often face. Overconfidence, for instance, leads to individuals believing that the problem they face can be overcome or solved, which case might not be true in the actual sense. There can also be a rationalization that because there is not a possible solution at sight, then there is no working solution to the problem they face, and thus necessitating changes being made to the projects in the areas of schedule, technical requirements and even the cost.

Siefert (2007) used an illustration of a simple study carried out of some equipment in a production company. He shows that using a piece of single production equipment that had been in service for a number of years. The equipment had suddenly portrayed some failures at the initial moments of its installation and operation. The failures were viewed not to be repeated nor were they related. As time progressed, the failures in the equipment increased and the parties concerned began worrying and thought that there was an urgency of correction being done to the equipment (Siefert, 2007). The responsible engineer had many years' experience being a project engineer as well as a designer, therefore exhibiting the cognitive bias of overconfidence. Another bias that was in play in this circumstance was the fear of displeasure of the management. Since the equipment had been well working over several years, the management wanted the failures to be addressed with the least possible cost and with little impact on the routine of the production company.

It was realized later that the actual causes of the failure were deficiencies in both the design and the hardware of the equipment. None of the deficiencies had portrayed itself in the previous stages. In fact, the intermittence of the failures acted as a mast to the real issues that were prevalent in the equipment. To address the deficiencies that were the issue in the equipment, the required corrective action included changes being done to both the software and the hardware. The equipment immediately returned to its normal function the moment the design issues were corrected (Siefert, 2007). In the process of risk management, in this case, the cognitive biases that were in action were the overconfidence bias and the fear to displease the management. The overconfidence bias made the engineer to ignore the initial signs and clues that, on re-examination, resulted in solutions whose implementation was never out to effect. This study is pertinent to the question of the relationship between cognitive biases and risk management.

The prospect theory that was put forward by Kahneman and Tversky (Kahneman and Tversky, 1979) seems to challenge the expected utility theory as regards decision making under risk management and mitigation. The prospect theory makes a contention that human decision making is made of two stages that are the editing stage and the evaluation phase (Kahneman and Tversky, 1979). The editing stage [which is relevant to the study carried out by Siefert (2007) involves the assessment of the probabilities and values through human utility functions. In an assessment of database risk management, it was observed that there were cognitive biases present in the risk management or mitigation plans (Siefert, 2007). The assessed database had 742 records and spans a period of five years. Smith (2006), for instance, asserts in relation to this that there is always a tendency of individuals doing an overestimation of small probabilities and large probabilities get underestimated in the process of analyzing and handling the question of the prevalent risks. The observation is drawn from the analysis of the statistics in Siefert's (2007) work. Siefert adds that as the risks become increasingly personal in nature, the gravity of the effect of the loss arising from the failure to mitigate them is taken more important than when the risks are less personal.

The examination of the data by Siefert (2007) shows that, there is a large portion of higher risk consequences compared to lower risk consequences. This observation fits perfectly in the theory that was put forward by Schwarz (1990). Gladwell (2008) talks about authority bias and how it works. According to him, authority bias has a great negative impact on the decisions made by the fact that individuals tend to be afraid to make some decisions (which would otherwise help in risk mitigation) for fear of irking the authority. The bias also works in a manner that the persons have a tendency of being afraid to question their authorities regarding the kind of decisions that they make concerning risk management approach they should take. He relates this to the risk management failure which led to the Korean Air flight plane crash in 1997. His suggestion was that the plane crashed following the fact that the co-pilot became too reticent to pose a challenge to the pilot concerning his decision making. Gladwell (2008) writes so as a consequent to the recommendation by the responsible investigators that the Korean Arline should, as between the captain and the officer, promote a free atmosphere so as to enable them to freely question the decisions made by each other.

Risk compensation is a kind of bias that has a significant negative impact on the kind of decisions that an individual makes regarding management and mitigation of risks. Option-Jones (2018) describes this bias to be situations where persons tend to engage in more risky activities when they feel more protected than when they are not. Option-Jones (2018) uses the conclusions drawn from data from various countries worldwide to show that when cyclists feel more protected, they are more likely to engage in more risky activities that include over speeding, cutting in front of cars and overlooking junctions. Wucker (2018) wrote that organizations, in most cases, act decisively address risk only when there is a serious risk issue. This is a fact that affects all the sectors whose decision making includes surveying risk management options. This also applies to risk management in mega projects, where the engineers who are mandated to make decisions on risk mitigation, for instance, will be reluctant to quickly rectify defects in the machines and equipment at the early stages when they bear in mind that the defective parts or equipment are insured by insurance companies. The Gambler's fallacy is also discussed by Option-Jones (2018), describing it to be the situation whereby investors and other decision-makers make an assumption that good luck will compensate for bad luck. The investors are often marred by the belief that the market will correct automatically, compensating them for the losses they incurred previously. An instance is where equipment of machine parts start developing defects. Studies have shown that a good percentage of decision makers overlook such defects owing to their trivial nature, believing that the defects will automatically be corrected over time as the machine or equipment is being used (Siefert, 2007)

Wucker (2018) discusses the bias of hyperbolic discounting, arguing that it causes some individuals responsible for making decisions to place more value on short-term goals which eventually act as a distortion on the long-term value. An example put forth by Wucker (2018) is that investors have the likelihood of putting off investments which are crucial or giving up the tough but essential decisions in the companies. The decision structures like short term earnings from their investments will create perverse incentives that amplify the hyperbolic discounting bias. When people that belong to a group of decision-makers tend to be very homogenous, they will have their ability to appropriately recognize and address risks when they arise (Option-Jones, 2018). This is consequent to the aversion that very minimal diversity can increase confirmation bias and heightens the difficulty to speak out concerning risks due to the fear to interfere with consensus. Michele (2018) puts it across that one of the approaches that can be used by organizations and companies while addressing this issue is by having the leaders of the organization or company soliciting their opinions prior to the meetings, or to anonymize major inputs that are required during meetings. On the biases and cost overrun, Cantarelli et al. (2010) describe the sources and causes of cost overrun in transport projects. They cite Mackie and Preston (1998) that give 21 sources of error and bias in the appraisal of transport projects. They majorly relate this to errors and measurement and appraisal bias (Cantarelli et al., 2010). The authors reach a conclusion that appraisal optimism is the greatest danger as far as the analysis of transport investment is concerned. The argument underlined in this bias is that it occurs for the reason of the fact that the information that the appraisal contains is often owned by scheme promoters with obvious incentives to bias the appraisal in a deliberate and unwitting manner.

In their work, Bruzelius et al. (2002) make a finding that the differences that occur between forecasts and the actual costs are not as a result of the difficulty in making the forecast. They argue that the forecast and actual cost differences attributable to the behavior of proponents of the project who engage in bias forecasting in a manner that it causes a decision to be made whose effect is the proceeding of the project instead of changing plans. In this regard, three issues are highlighted, which include long term commitment to the project, the likelihood of underestimating tenders so as to get the proposals accepted and rent-seeking behavior for special interest groups. In the attempt to categorize the causes and explanations for cost overrun in projects, Cantarelli et al. (2010) find that there are technical explanations, psychological explanations, and political explanations. They describe the psychological explanations to be those that are based on the concepts of planning fallacy and the concept bias. These explanations involve the cognitive bias of the people and their cautious attitudes towards risks in their making of decisions (Cantarelli et al, 2010).

*4.3 Synthesis of the Study Constructs*

The primary constructs under investigation have been discussed extensively with respect to project management in megaprojects. The role of this section is to synthesize the interaction between the constructs involved in cognitive bias and decision-making amongst project managers involved in megaprojects. Evidently, this study borrows heavily from research in behavioural finance to integrate, elaborate and justify the predicted connections. For instance, the current study seeks to determine the causes of cost-overrun in megaprojects and determine how biases such as over optimism influence decision-making leading to or as a result of cost overrun. Further, this investigation seeks to identify the cognitive biases that are associated with decision-making. These have been discussed independently and with respect to other constructs as demonstrated in figure 4.1. Ultimately, the aim is to investigate the influence of cognitive bias on decision-making. Essentially, the role of this section is to integrate the details from the entire chapter.

Cost overruns are undesirable occurrences in any projects, especially, megaprojects where massive amounts of capital have been invested. From the research synthesis above, cost overrun may occur as a result of faulty decision-making or other factors such as the economic environment. Project managers are often forced to make decisions in light of growing costs and uncertainty associated with the result of the decision. The aforementioned predicted relationship is idealized in figure 4.2 below. In turn, decisions associated with a cost overrun are influenced by cognitive biases such as over optimism as shown in figure 4.2 below. Within the same sphere, personality traits are closely associated with cognitive biases which ultimately influence decision-making in the face of risk and cost-overrun in mega projects. The relationships between the variables are easily understood from the description of the individual constructs in preceding sections of this chapter. Demographic characteristics such as the age, gender, and level of education of project managers are known to play a role in the decision-making dimensions of project managers involved in megaprojects. For instance, age could be related to experience and better decision-making overall amongst decision-makers, thus, justifying the need to include demographic characteristics in this investigation. A point of emphasis is on the multilevel nature of the relationships clearly demonstrated in figure 4.2.

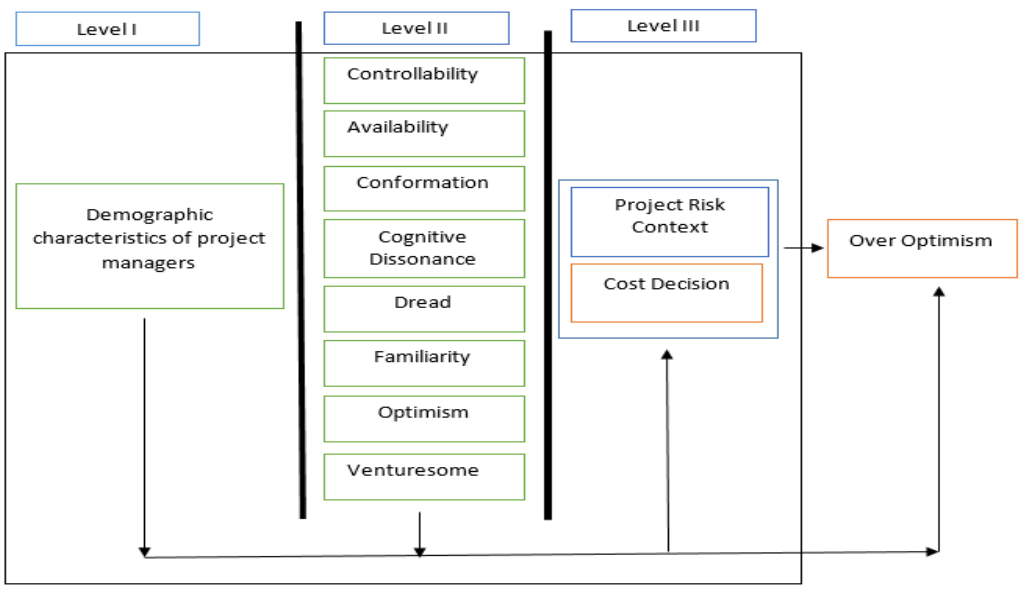


*Fig.4.2. Showing the multilevel conceptualization of the individual research variables;*

The figure above helps to demonstrate how this research predicts the constructs are related to each other from conceptualizations retrieved from other studies. Notably, Fig. 4.2 guides the statistical tests selected to investigate the relationships between the variables (that is hierarchical regression). More definitively, the relationships are hierarchical linear. The first level is ascribed to the demographic characteristics of the project managers involved mega projects. Ideally, dependent variables are examined at lower levels of the multilevel model; however, this study is proposing hierarchal regression to exam if there is any distinct strength between the first and second levels. The model is designed based on intuition and the nested nature of variables. Project managers demographic characteristics influence personality traits which are closely associated with cognitive biases that affect decision-making in megaprojects. The third level of the hypothesized model encompasses cost decision and project risk. Cost decisions in this context refer to decision-making by project managers in the face of cost overrun or decisions related to cost. A key focus is attributed to over optimism which is a cognitive bias whose impact on megaprojects is a major concern. Notably, over optimism is not conceptualized within the three levels but outside the model since cognitive biases are ascribed to the second level as shown in figure 4.2.

*4.4 Summary*

The above chapter has provided a detailed conceptual framework of the on-going research. The multilevel variables of this study were isolated for independent study to allow for better integration. Notably, justifying the existence of the supposed relationships is crucial for steering the methodology and specifically, the types of statistical tests to be conducted. The individual research variables used in the analysis and whose data is collected from the study participants are discussed in the context of other underlying constructs. Further, every variable is discussed independently listing the assumptions on which it is founded, the constraints and its application as observed from multidisciplinary research. In addition, the relationships predicted in this investigation are rationalized from the viewpoint of past studies and scholastic investigations. In the end, a synthesis of the constructs is detailed to simplify and integrate the extensive discussion in preceding sections.

# Chapter Five: Research Methodology

## *5.1 Introduction*

The on-going section presents a discussion of the research philosophies and strategies implemented in the study. This serves to align the work with commonly accepted reasoning and allow room for accurate categorization of the research within the broader field of knowledge. Further, this section details the research methods and design alongside with their justification. The objective of the on-going section is to ensure that readers and critiques alike can benefit from well-defined research; this will allow comparison with other similar studies and help future researchers to advance the topic.

## *5.2 Research Philosophy*

Research philosophy is a wide topic that encompasses numerous stances, which ultimately shapes the research's methodological assumptions, by justifying the reasons why various methods are used to explore a given phenomenon. In order to explicitly justify various techniques that will be used to undertake this study, it is important to have a quick overview of each of the philosophical stances, particularly on business and social sciences studies. This will help in relating each of the philosophical assumptions to the current research's problem statement and context, in order to identify one which in the researcher's judgement is ideal in meeting the aim of the study. Fundamentally, in order to objectively achieve this, particular emphasis will be put on the reasons underpinning different philosophical classifications, and the implications of each discussed philosophy before a justification is presented.

### *5.2.1 Overview of Philosophical Stances*

In social sciences, the main philosophical approaches that can be used to undertake studies include pragmatism, positivism, realism, and interpretivism respectively (Collins, 2010). Each of the philosophical reasoning has unique characteristics and general ways of viewing sources of knowledge, and how such process of obtaining or developing a body of knowledge should be undertaken. In essence, the purpose of research philosophy helps to determine how data should collected, organised, synthesised, and be interpreted in order to enable a researcher to make inferences concerning a given area of focus (Ramanathan, 2008). This makes it possible to determine whether one needs primary or secondary data, in order to obtain answers to raised research questions. Further, this implies that one need to be aware and also be able to formulate assumptions and beliefs concerning a topic, what has already been achieved in the preceding chapters. It is also important to appreciate the fact that although the main philosophical stances for social science researches such as in project management like is the case in the current study are mainly four, the process of determining which one to be used entails consideration of a number of ontological and epistemological stances (Wilson, 2010). The figure provided below makes it possible to identify which main areas are usually focused in establishing how a selection of a philosophy is justified in research.

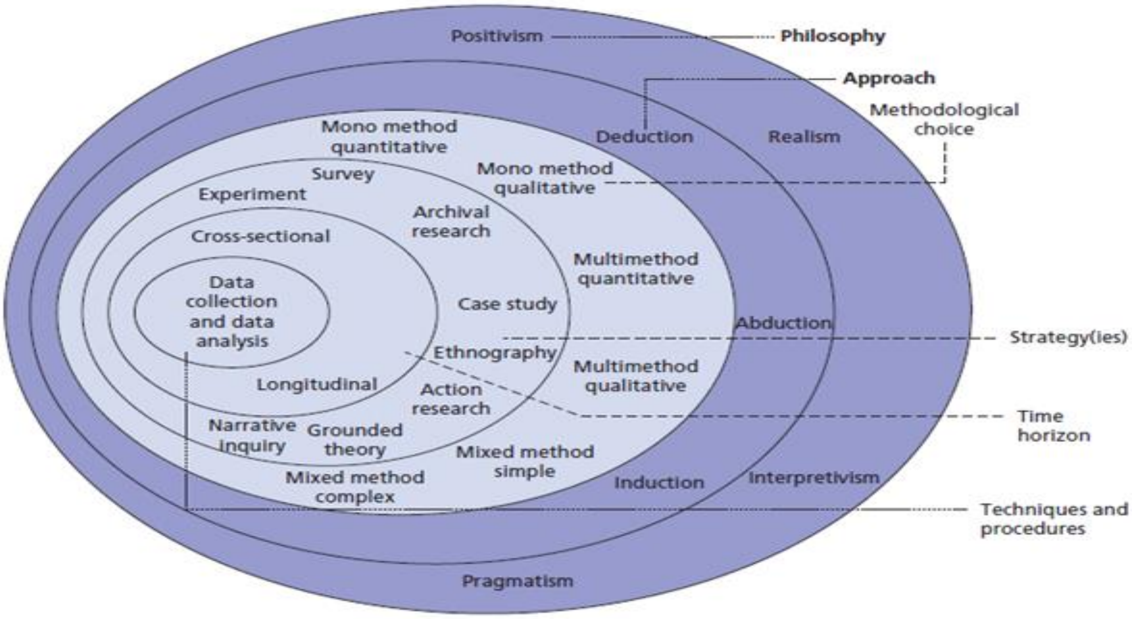


Figure 5.1: Research Philosophy Onion

Source: (Saunders, Lewis and Thornhill, 2012)

From the research onion provided as figure 5.1 above, it is clear that although the main concern is on the outer layer, there many other aspects that matter a lot in making a decision, such as the reasoning approach whether it is induction, abduction or deduction, as well as the nature of data being targeted. Nonetheless, after a decision has been made on which philosophy is deemed to be suitable based on the underpinning problem statement, then other techniques are easy to establish. Therefore, the on-going discussion will critically examine the fundamental features of each philosophy so as to justify the one suitable.

While focusing on realism, the assumption is that human mind should be independent in undertaking a study, by adopting a scientific approach in knowledge development. According to the philosophers supporting this view, they agree that realism is often divided into two categories, namely; direct and critical (Novikov and Novikov, 2013). While a direct realism is seen as a naïve way of reasoning in which case knowledge should be understood the way it is perceived, a critical realism considers images and sensations received by the human mind to be deceptive, hence a more critical approach in interpreting them is necessary (Saunders et al., 2012). Moreover, critical realism opposes the direct realism approach by indicating that what one observes is not what actually the underlying meaning of knowledge is, and that it is important to question the existence of realities and truths in the images conceived by human senses (Novikov and Novikov, 2013). Another important feature differentiating direct and critical realists is that the former consider the world as being static and never changing, while the latter realists consider the world to be dynamic and hence knowledge keeps on changing and developing in manner corresponding to the interactions between humans, organisations, environment, and researched realities (Novikov and Novikov, 2013). Based on these assumptions, most researchers adopt critical realism, and the following table helps to demystify the methods of research that are associated with critical realism approach.

Table 5.1: Critical Realism Research Methods

| Ontology | Epistemology | Axiology | Typical methods |
|---|---|---|---|
| Stratified/layered (the empirical, the actual and the real)<br><br>External, independent Intransient<br><br>Objective structures Causal mechanisms | Epistemological Relativism<br><br>Knowledge historically situated and transient<br><br>Facts are social Constructions<br><br>Historical causal explanation as contribution | Value-laden research<br><br>Researcher acknowledges bias by world views, cultural experience and upbringing<br><br>Researcher tries to minimise bias and errors<br><br>Researcher is as objective as possible | Retroductive, in-depth historically situated analysis of pre-existing structures and emerging agency. Range of methods and data types to fit subject matter |

Source: (Saunders et al., 2012)

According to the table given on 5.1, above, it is clearly elucidated that a direct realist is external and independent from the study, using objective reasoning and causal associations as the main ontological foundation to investigate a phenomenon. Further, such a researcher embraces explanation as the main contribution to a body of knowledge, as well as the use of relativism as the main epistemological approach (Wilson, 2010). However, although the researchers adopting this philosophy seeks to minimise errors and bias in order to remain objective, they often acknowledge the fact that bias cannot be completely eliminated from the world views. Nonetheless, in ensuring that objectivity is achieved, this stance allows researchers to adopt that method of data collection which fits the situation at hand, giving room for the scholar's judgement (Collins, 2010).

While focusing on positivism philosophy, it is important to appreciate the fact that it cannot be explained in a succinct and precise manner given that it is applicable in different contexts. However, its general interpretation demonstrates that a body of knowledge is best developed through science as the only way through which truth about a certain phenomenon can be examined and interpreted (Ramanathan, 2008). Ideally, positivism philosophers argue that the only way of gaining actual knowledge is through observation by the use of senses, including an approach such as measurement that is trustworthy. Moreover, researchers' roles under this stance are limited to that of collecting and interpreting data only (Wilson, 2010). As a matter of fact, the findings obtained in such studies can only be charaterised as being observable and quantifiable. According to the positivists, such quantifiable observations should result to statistical analyses, to make it possible in testing hypotheses, as well as explaining causal relationships among variables. In its philosophical foundation, this stance is in line with the empiricist view which maintains that it is from experience that knowledge must stem from (Collins, 2010).

The rationale behind positivism is to make researchers independent from the studies as much as possible, by eliminating any form of human interests from the phenomenon being investigated. This gives room for the researchers to adopt a deductive approach as opposed to an inductive approach as opined by Crowther and Lancaster (2008). In this case, instead of concentrating on meaning, positivists put their focus on facts, leading to a production of research inferences that are purely objective as maintained by Collins (2010). The following are the specific characteristics for positivism approach that best illustrate its application to a research context.

Table 5.2: Positivism Research Philosophy

| Ontology | Epistemology | Axiology | Typical methods |
|---|---|---|---|
| Real, external, independent<br>One true reality<br>(universalism)<br>Granular (things)<br>Ordered | Scientific method<br>Observable and measurable facts<br>Law-like generalizations<br>Numbers<br>Causal explanation and prediction as contributon | Value-free research<br>Researcher is detached, neutral and independent of what is researched<br>Researcher maintains objective stance | Typically deductive, highly structured, large samples, measurement, typically quantitative method of analysis, but a range of data can be analysed |

Source: (Wilson, 2010)

According to the details provided on table 5.2 above, there is an assumption of universalism about truth as the main ontological assumption in this philosophy, while the main epistemological assumption is the use of numeric data in establishing law-like generalisations. Moreover, the philosophy focuses on value-free studies by maintaining an objective stance as the main axiological premises (Easterby-Smith, Thorpe and Jackson, 2008). In this regard, the philosophers supporting this stance insist on using highly structured and deductive methods, in obtaining data from large samples for measurement through a quantitative analysis approach. Often, there is a general practice of selecting large samples from a population in order to enhance validity and reliability (Wilson, 2010). As a matter of fact, this philosophy is ideal for studies which seek to establish a relationship between variables, as well as lead to statistical results as ideal measurements for interpretation (Easterby-Smith et al., 2008). The fundamental scientific principles that positivism relies on include; science is deterministic and mechanistic, science makes use of method, and that it deals with empiricism (Ramanathan, 2008).

Apart from positivism, another philosophy is interpretivism, which is often viewed as the opposite to the former. Fundamentally, the main feature of interpretivism is the integration of human interests in a research in interpreting the observations, hence being considered by positivists as being subjective as opposed to being objective. Moreover, interpretivists strongly maintain that access to knowledge's reality whether socially constructed or given is only possible through constructions which are social in nature such as shared meanings, consciousness, instruments, and language respectively (Myers, 2008). On this foundation, it can be seen that interpretivism developed from a critique of positivism, in which case a qualitative analysis is preferred to a quantitative analysis as maintained by Myers (2008).

Nonetheless, there is a close association of interpretivism with an idealism stance, in which case diverse approaches such as hermeneutics, phenomenology, and social constructivism are grouped together, as they all oppose the positivism approach (Littlejohn and Foss, 2009). Interpretivism suggests that since people are different, researchers must use techniques that will enable them to appreciate the social differences and views from people in the society (Saunders et al., 2012). Moreover, it is important for different aspects to be reflected by employing different techniques, but meaning must be focused on as opposed to facts. The most important feature of interpretivism is employing observations and interviews, although focus is on qualitative data as opposed to being quantitative. Moreover, it does not limit its focus on primary data only, as secondary data can also be used in evaluating different aspects of a given phenomenon (Littlejohn and Foss, 2009). The following table gives a summary of the features underpinning the interpretivism stance.

Table 5.3: Interpretivism Research Philosophy

| Assumptions | Positivism | Interpretivism |
|---|---|---|
| *Nature of reality* | Objective, tangible, single | Socially constructed, multiple |
| *Goal of research* | Explanation, strong prediction | Understanding, weak prediction |
| *Focus of interest* | What is general, average and representative | What is specific, unique, and deviant |
| *Knowledge generated* | Laws<br>Absolute (time, context, and value free) | Meanings<br>Relative (time, context, culture, value bound) |
| *Subject/Researcher relationship* | Rigid separation | Interactive, cooperative, participative |
| *Desired information* | How many people think and do a specific thing, or have a specific problem | What some people think and do, what kind of problems they are confronted with, and how they deal with them |

Source: (Myers, 2008)

According to the table provided on 5.3 above, interpretivism is founded on the distinguished differences in the assumptions of focusing on the goal of a research and the nature of reality being sought among other components. Precisely, it is seen to be the opposite of positivism in each of the above constructs as it focuses on multiple and socially constructed realities as opposed to single and objective ones (Myers, 2008). In addition, it has a weak prediction and understanding of the research as opposed to positivism, while focusing on the interest being on what is found to be unique and deviant as opposed to what is strong and representative. Further, it is the belief of interpretivists that research participants must be allowed to interact with the researcher, while positivism opposes this view and terms as a potential opportunity to yield subjective inferences (Myers, 2008).Finally, while focusing on pragmatism philosophy, the general view is that constructs or variables can only be accepted as being true if they are deemed to be supporting action. According to pragmatists, research undertakings and world interpretation can be achieved in a multiple ways, and none of the many ways can independently provide the entire picture as there are many realities (Collins, 2010). In this regard, pragmatists do not see positivism and interpretivism as opposite philosophies but rather paradigms that are mutually exclusive about source and nature of knowledge. Therefore, most of social sciences should fall in any one of the above paradigms, but they can modify their studies to combine elements from the two paradigms especially by the modern and seasoned researchers, leading to a mixed methodology that uses both, simply regarded as a pragmatism approach (Collis and Hussey, 20104). This modification brings a new continuum of searching for knowledge, which embraces objectivity and subjectivity in understanding a single phenomenon, hence using one approach to eliminate the weaknesses of the other in a study (Saunders et al., 2012). According to pragmatism, this enhances reliability of a study and leads to inferences that are backed up with solid evidence concerning a phenomenon being investigated (Collis and Hussey, 2014).The main feature of pragmatism that differentiates it from positivism and interpretivism is the ability to use more than one approach in the same study, to ensure a robust outcome is obtained. While this is seen as an ideal approach by most scholars, it often presents a number of challenges to researchers (Wilson, 2010). Firstly, it makes the scope of the study to be broad, which needs more time and resources. Further, it is applicable to situation where interpretivism approach is best suited based on the fact that interviews cannot be undertaken on a large sample of population. Moreover, it is usually admissive of subjectivity and researcher's bias, as well as bias by the research participants and they can easily be influenced. Having expounded in detail each of the philosophies, the following section justifies the selection of the most ideal based on the context of the current study.

*5.2.2 Justification of the Philosophy Choice*

It is important to note that as expressed by Collis and Hussey (2014), a researcher can make a selection of research philosophy from the three commonly used, namely; positivism, interpretivism and pragmatism. However, in this study, a special consideration was put on the nature of research questions, objectives, problem statement and hypotheses. Firstly, the table below demystifies the differences between the three main philosophies for business researches, excluding realism research which is not commonly used as opined by Collis and Hussey (2014).

Table 5.4: Positivism, Interpretivism and Pragmatism

| | **Research approach** | **Ontology** | **Axiology** | **Research strategy** |
|---|---|---|---|---|
| *Positivism* | Deductive | Objective | Value-free | Quantitative |
| *Interpretivism* | Inductive | Subjective | Biased | Qualitative |
| *Pragmatism* | Deductive/Inductive | Objective or subjective | Value-free/biased | Qualitative and/or quantitative |

Source: (Collis and Hussey, 2014)

From the simplified differences, it is clear that current study can be classified under the positivist approach since this philosophy focuses on quantitative strategy, in which case it will be possible to test hypothesis through statistical analyses. This is because the current study has proposed a number of hypotheses, which cannot be tested through the use of the other philosophies. Secondly, the researcher would like to adopt a deductive approach as opposed to an inductive approach which is subjective, hence enabling the entire researcher to be objective in nature. Thirdly, it is important to eliminate any type of bias from the study by maintaining a value-free axiology as supported in table 5.4 above. Evidently, from the research aims and objectives listed in earlier sections, the current investigation views the variables under investigation independently and dispassionately. In essence, the features adopted in this investigation can be classified under the positivist research approach. The justifications for the above classification are based on three spheres of research that differentiate the positivist research approach and its contrasting conceptualization; the interpretive approach (Thompson, 2015). The first sphere is the relationship between the individual and society. Positivist research contemplates that an individual's behaviours and actions are shaped by a society which is in contrast to interpretivism ideologies that argue for the power of a consciousness that controls the actions of individuals (Thompson, 2015).

More clearly, supporters of the positivist approach suggest that societal facts exercise more control over the actions of an individual as compared to their own thinking and personal devices (Thompson, 2015). Like the on-going investigation, research encompassed under the positivist paradigm explores discoveries that are generally recognizable and quantifiable. With regard to its ontological perspective of reality, the positivist paradigm adopted for this research is solidly found on using readily observable, measurable, discrete events that impart in a conspicuous, objective and standard way. Further, the role of the researcher is disassociated from the actual investigation. In fact, strict followers of the positivist paradigm maintain that ideally, the researcher should be viewed independently of the study as is the case in the current investigation. Notably, the selection of the positivist paradigm for this research is the need for emphasis on facts rather than actual meaning. Thus, in this investigation, the researcher maintains low levels of interaction with the study participants to uphold the independence assumption. Further, the positivist approach typically calls for a deductive approach where findings are viewed in the context of published theories and concepts. Thus, there is a massive reliance on information from multidisciplinary investigations to making meaning of the hypothesized associations and the results of the investigation.

An incredible number of scholars and researchers who ascribe to viewpoint and thinking of the worldview concur with this explanation and definition. Oneself overseeing, autonomous and objective presence of truth can be viewed as a definition and importance of positivism in various studies. The positivist approach has been blamed for harbouring an epistemological burden emerging as a result of the positivist way of thinking. There are different issues of enrolment or initiation and general real nature. Further, the positivist paradigm has not provided persuasive and bona fide clarification on how the knowledge can sufficiently symbolize a mind-self-governing truth. Therefore, the positivism is seen as self-conflicting due to the fact that during data collection the events under investigation are not happening on their own but because of the “independent” researchers’ intervention. Accordingly, from this, it could be developed that positivism is definitively globular and that despite its assumed reasonableness, it could simply research happenings or occasion that are formed by the expert (Stahl, 2003).

More importantly, the utilization of essential judgment in inspecting unique research locations using different measures, tests, plans, and examinations are imperative to permit an association on a considerable appreciation of a wonder (Aliyu, et al., 2014).From the on-going investigation, the actions of CEOs, project managers and stakeholders involved in decision making are viewed with regard to social forces. Moreover, a cognitive bias is viewed as a construct that is modelled by social forces more than innate thinking of the social actors. Further, the inclusion of demographic characteristics of the sample under study indicates the importance placed on social forces in modelling daily behaviour and actions of individuals.

Another sphere of research leading to the classification of the research philosophy as positivist is related to the ultimate focus of research (Thompson, 2015). Positivist research attempts to unearth the truth about reality from an individual's actions and behaviours in the same way that scientific research has provided guidelines about physical reality (Thompson, 2015). This investigation views the individuals under research (CEOS, Managers, and Stakeholders) objectively by dissociating the research from the actual experience of individuals. Ultimately, the above allows for measuring of the constructs under investigation independently of the social actors. Ideally, this research attempts to explain the relationship between cognitive bias and decision making using the identified variables such as personality traits, cost overrun, over-optimism and risk; thus, a positivist approach is best suited for the study.

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*5.3 Research design*

A key component of this research following the above description is the research design. This section details the methods chosen for this investigation and its justification. Notably, research designs often rife with inconsistencies such as bias and insignificant results; however, this study identified and acknowledged weaknesses in the designs and followed research recommended guidelines. Distinctly, from the description presented in the research philosophies, the current study is quantitative. The aforementioned research designed is motivated by the nature of questions this study seeks to answer, the sample size used, and the amount of objectivity intended by the researcher. In specific, the type of data collected and tests to be conducted are most fit investigated under the quantitative research design. Furthermore, a quantitative approach is most suitable to ensure generalizability of the results (Langkos, 2014) to other spheres of knowledge where cognitive bias and decision making are under investigation. In addition, a quantitative approach allows independence of the research from the researcher's bias which is quite common in qualitative research (Langkos, 2014). The current study is quantitative descriptive as it seeks to measure the relationship between variables and establish whether any associations exist.

Essentially, quantitative research involves the deliberate examination of phenomena by socially quantifiable information and scientific or computational methods. Quantitative research is generally driven in human sciences using statistical techniques to accumulate quantitative data. In this examination method, experts and investigators leverage numerical structures and theories that identify with the variables under scrutiny. Because the ongoing investigation is quantitative, it falls under cross-sectional research. According to Earl (2010), this type of study is adequately defined as a cross-sectional survey. In the end, the structure of quantitative research calls for descriptive and inferential statistics involving the testing of hypotheses and significant differences. Another key feature is the reliance on tabulation to present results; this is evident in the analysis chapter of this study.

Even with the above strengths of the quantitative design, weaknesses still exist. For instance, Langkos (2014) criticized the use of a quantitative design due to the tendency to misrepresent the target population under research. In this investigation, however, a thorough review of secondary sources of information serves to supplement the results of the investigation on cognitive bias and decision making in Megaprojects. Moreover, the systematic nature of the quantitative approach guarantees meaningful results.

Notably, the personal experiences of the CEOs, Managers, and Stakeholders of mega projects cannot be investigated as this requires a qualitative approach. Despite that, the ongoing study posed questions and hypotheses that are best answered and explained by methods encapsulated in the quantitative research design. Moreover, similar studies investigating one or two of the variables under scrutiny in this paper opted to use a quantitative approach. Andrić, et al.(2019) used a mixed research approach, however, they noted that the quantitative approach was best suited to investigate cost overrun and its relationship with other variables such as cost performance in Mega infrastructure projects. Another similar study by (Esa, et al., 2016) also adopted a quantitative approach to measure the relationship between cost overrun and behavioral biases.

The aforementioned examples demonstrate the accreditation of the research design by other scholars investigating cognitive bias and decision making or related variables. Even with the above justifications for using a quantitative research design, there still exist limitations on the part of quantitative research. For instance, faults individual quantitative studies for being subject to bias; instead, he recommends using a quantitative meta-analysis technique where the results of multiple quantitative studies are synthesized to generate knowledge. Moreover, Hallion and Ruscio (2011) claimed that many quantitative studies fail to answer their research questions or meet their objectives, thus, the use of a meta-analysis is recommended.

Nonetheless, an examination of the research questions posed in the on-going investigation indicates that a quantitative approach is best suited for the investigation. Thompson (2015) claimed that since a positivist approach views individuals objectively, then quantitative approaches are required as they are less susceptible to subjectivity as compared to qualitative methods. Further, the adoption of quantitative research methods helps to ensure the results are valid and reliable in contrast to qualitative research methods that may at times forego reliability for more validity (Thompson, 2015). Additionally, given the fact that size of mega projects is also measured numerically, it will be prudent to adopt a quantitative study so as to make it easier to analyse numeric data. Due the above justifications and type of philosophy used, the researcher decided to use quantitative as opposed to qualitative methodology.

*5.4 Research approach*

A top-down approach has been selected for this study; this is motivated by the size of the sample under investigation and the ultimate goal of the study. Specifically, the current study aims to confirm the hypothesized relationships of variables related to cognitive bias and decision making. Thus, a deductive approach is most suitable. Moreover, the end product of the results is an explanation of the observations instead of the formulation of a new theory as is common in the inductive approach. Evidently, from the discussion, the constructs under investigation are analyzed from existing knowledge and already formulated theories. Eventually, a conclusion of the results is given based on the formulated hypotheses, observations, and premises. The deductive approach is highly recommended for quantitative research due to the necessity of statistical procedures to test the hypotheses formulated from background theory.

Notably, the over-reliance of the deductive approach on observations to offer conformations about reality has been faulted as a possible weakness. In specific, Langkos(2014) claimed that faulty observations lead to erroneous inferences, thus, in this study, the collection of observations from study participants is systematic and well organized to mitigate errors. Moreover, reliability and consistency tests are run on the data to ensure outlier points are identified and unexpected behavior in data is investigated intrusively. A deductive approach to research entails "building up speculation (or theories) in light of the existing hypothesis, and afterward structuring an examination technique to test the hypothesis (Wilson, 2010).

Further, the deductive approach emanates from the specific to general as shown in the current study where hypotheses and the research objectives have been identified to be analyzed in the context of the wider literature (Gulati, 2009). Further, a deductive approach allows this study to test the associations between the variables and interpret their meaning using a wider perspective. The deductive methodology can be clarified by the methods for speculations, which can be gotten from the suggestions of the hypothesis. Ultimately, the deductive approach seeks to draw inferences from premises. Even though the ongoing investigation employs the deductive approach loose features found in inductive research may be employed to help meet the objectives set out at the beginning of the investigation. This is recommended by Messner, et al. (2009)

especially if the results gained from the study can be used to formulate new concepts or theories.

*5.5 Target Population*

In this study, the overall aim is founded on the need to examine the influence of cognitive bias onm decision making in mega projects. As a matter of fact, the individuals charged with the responsibility of makingn decisions are those in managerial positions. Further, given that focus is narrowed down to projects, it implies that the target popualtion of the study are individuals at the managerial positions, specifically for mega projects.

*5.6 Sampling and Sample Size*

A myriad of sampling techniques exists based on their primary categorization based on the randomness initiated during the selection of participants. Probability sampling techniques are typically recommended by researchers to minimize bias resulting from subjective selection of study participants. On the other hand, non-probability techniques allow for greater flexibility in the selection of the study sample to suit the role of the study. Even though the selection of participants for this investigation is systematic, there is an inclination towards random sampling techniques. Thus, the sampling method resembles that of purposive sampling and expert sampling where the sample is selected based on the purpose of the investigation. The selection of individuals in project management only aligns the sampling technique employed in this study to expert sampling. Notably, the on-going investigation employs the most adequate method aligned to the research strategy and the nature of objectives that the study aims to meet.

This research is interested to gage the perception of project managers on the cognitive biases that might influence decisions leading to cost overrun in mega projects. Normally researchers in social science work on the basis of 5% error or 95 % confidence level to estimate the size of the sample. Further, given that the adopted research philosophy has supported the use of quantitative data, it is important that the sample size is determined statistically. Moreover, a statistical sampling technique minimises chances of biased selection of the elements to be involved a study. As a matter of fact, this enhances objectivity and allows equal chances of potential research population members to be involved in a given study. There is no current database or statistics that show the number of project managers working on mega projects. Since no data are available on the proportion of project manager working on mega projects, one might estimate that 5% of project managers in the UAE work on mega projects. Rose, et al., (2014) suggested the following formula for estimating the sample size where the population is unknown.

$$n = \frac{(1.96)^2 pq}{d^2}$$

Where n is the sample size, p = proportion of the project managers having the characteristic (i.e., worked in mega projects, q = 1-p and d = the margin of error. Thus, using a conservative estimate that 8 percent of the project managers work in mega projects (p= 0.08, q =1-0.08= 0.92), and within 5 percent margin of errors (SE= 0.05) at a confidence level of 95 percent, the minimum sample size (s) would be calculated as per the following equation

$$n = \frac{(1.96)^2 pq}{d^2}$$

N = $(1.96)^2$ (0.06) (0.94)/$0.05^2$ =86

Thus, the minimum sample size required for this study is 86 project managers and the sample consisted of 101 individuals from managerial positions in firms involved in mega projects. The sample encompassed individuals from diverse races and genders, thus, capping bias that may influence the interpretation of the results. The sample size guided the hypotheses tests to be conducted on the data thus, played a major role in the selection of the research design, research approach, data collection, and analysis. The following sections detail the collection of information from the study participants, the synthesis of the information and the interpretation.

*5.7 Questionnaire design*

The primary research instrument in this investigation is the questionnaire. For this research, the questionnaire was selected deliberately due to the number of respondents' data ought to be collected from and the intrinsic features of the research described in preceding sections. Moreover, the questionnaire is known for allowing the collection of quantifiable data that can be easily analysed. This investigation acknowledges that questionnaires may be misleading if the formulation of the questions is not free of error. Further, questionnaires remain susceptible to bias on the part of the research especially in the formulation of questions and administration of the instrument. Therefore, the data collected from the questionnaire is analysed for consistency, common bias and reliability to ensure that ultimately only meaningful inferences are made. In addition, the questions are simplified and clarified to ensure respondents understand the context of the questions and avoid misinterpretation that could affect the quality of this research.

The data required to answer questions related to the demography of the individuals, their personality types, how they approach different decision scenarios and the level of knowledge they had on the existence of cognitive bias. Demographic variables gathered in the questionnaire were gender, culture, company size, job position, and work experience. Other four main variables are defined from the questionnaire data for further statistical tests. "Cost decision making in mega projects" coded as DM1 in this study is the first main variable; it attempts to inquire whether overall decision making has an influence on project cost. "Risk decision-making" coded as RM in this study is aimed at measuring whether risk decision making is a key component of mega projects. In essence, the variable aims to quantify whether mega projects are inherently characterized by risk decision making. The third variable is linked to cognitive bias, thus, 12 personality traits linked to different individuals are investigated alongside decision making to determine if there is a significant relationship and if there is, what does it mean? In specific, the influence of the identified personality traits linked to cognitive biases is checked against cost overrun and overall decision making. The final variable is related to optimism and decision making. Evidently, over optimism is closely linked to cognitive biases, thus, its influence on overall decision making in mega projects in investigated.

### *5.7.1 Types of Questions*

According to research, the questions posed from a questionnaire can be developed from existing questionnaires especially from similar studies or adopting them directly (Dillman, 2017; Fink, 2003). The on-going investigation incorporates this strategy to ensure the questions are consistent with broad research in the field. Even though, the questions are based on existing studies they are adjusted to fit the role of the investigation. According to Fink(2003) scholars who develop their own research questions achieve a level of flexibility that is useful in contextualizing and conceptualizing the research constructs under investigation. The questionnaire adopted for the on-going study is primarily composed of closed questions. According to Dillman(2017) close ended questions are difficult to interpret as they restrict respondents' responses to a specific set of outcomes. In this study, they are based on the 5-point Likert scale. In the end, the respondents are expected to give ratings based on the questions. Even with the claim that closed questions are difficult to interpret, their analysis is quite straightforward as soon as they are coded. On the other hand, open ended questions giving participants freedom to explain their responses are easy to interpret but difficult to analyses as a lot of information is usually collected from them. The design of the questions also takes into account recommendations by scholars to organize them consistently for different ratings throughout the questionnaire to avoid confusion. Questions collecting demographic data are also closed to help frame the research to a specific group of individuals (project managers), the range of their work experience, the number of employees in their organizations, gender and cultural background.

### *5.7.2 Measurements*

Different types of data exist for quantitative and qualitative studies. Quantitative research is usually founded on two basic data types; (1) categorical data and (2) numerical data. The latter is associated with actual counting and the number of responses or participants supporting a specific construct while the latter is based on the classifying responses into sets with innate similar features (Blumberg, et al., 2008). Categorical data can further be classified in nominal data and ordinal data. Nominal data is related to the incidence of responses to questions on a specific construct while ordinal data is related to the rank or order of priority of strength of the responses (Saunders, et al., 2016). On the other hand, numerical data into interval and ratio data based on whether the comparative difference between the data can be computed (Blumberg, et al., 2008; Saunders, et al., 2016). The differences can be computed for ratio data and not for interval data. The subsets of the interval and ratio data are continuous and discrete data which is related to whether a construct can take a specific value within a range (Blumberg, et al., 2008). Discrete data takes specific values within a range while continuous data does not (Blumberg, et al., 2008).

### *5.7.3 General Structure*

The questionnaire offered to respondents in current investigation can be divided into two distinct sections. The general information section collects data on the role of the participant within an organization, their work experience, the size of the firm they work in with regard to the number of employees, the gender they identify with and their cultural background (race or ethnicity). Evidently, three spheres are examined from the general information, the demographic features of the participants, their professions and the characteristics of organization they work for.

### *5.7.4 Specifics*

The specific part of the questionnaire comprises of questions that are crucial to meeting the objectives of the on-going investigation. The section is divided into five intuitive sections based on the constructs under investigation. The table below effectively describes the four areas of focus.

| Construct | Description |
|---|---|
| Decision-making in mega projects | Participants are tasked with a five-point Likert scale assessing how they perceive the likelihood of incorporating different factors decision-making in Megaprojects. |
| Risk and decision-making in mega projects | Participants are tasked with a five-point Likert scale assessing how they perceive the likelihood of incorporating different factors into risk decision-making in Megaprojects. |
| Personality traits and cost decisions | Participants are asked to respond to a five-point Likert scale on the level of agreement with statements about the interplay between personality traits and cost decisions. |
| Reasons for cost overrun in mega projects | This section requires participants to rate researched justifications of cost overrun in mega projects. Five factors are identified and ranked with percentages. |

*5.7.5 Questionnaire data coding and validation.*

The data collected from the specific part of the questionnaire is coded using different weights as is common for Likert scale questions. Ultimately, the data is fed into SPPS for analysis. The coding associated with Likert responses is commonly used and is known to be simple and straightforward. Even so, there are numerous challenges as important information may be missed by restricting the responses of participants to a given set. Aside from presenting the questionnaire to a pilot group of project management students to test for validity, the questionnaire is also examined in the context of similar research studies and statistical measures such as the Cronbach's alpha.

*5.8 Pilot Study*

In order to test whether the designed data collection instrument is free from bias and can objectively lead to the answering of the research questions, there was need to undertake a pre-test. A pre-test in this case offered the researcher an opportunity to examine the various questions from different perspectives as proposed by Trochim (2006). The procedure for undertaking a pilot study involved the distribution of the questionnaires to 5 respondents playing a role of project managers in mega projects, although the final data collection process was not undertaken in that sampled project for the pre-test. The reason behind this si to minimise chances of bias in all means possible given that the population from a pre-test sample could be having prior information concerning the study. The outcomes from the pre-test exercise were used to test for reliability and validity as explained below.

*5.8.1 Reliability*

The issue of reliability of research is particularly important in quantitative analysis. The reliability of the research is necessary to ensure that the research procedure will yield consistent results. Generally, reliability is attributed to respondent error, respondent bias, researcher error, and researcher bias.  This study's respondent error is minimised by requesting the respondents to answer each question before moving to the next. Respondent bias was eliminated by using a random sampling method. Also, statistical methods were used to check for common bias. The internal consistency of the research instrument was checked using Cronbach's alpha. All the primary constructs of the current investigation are checked for reliability using the Cronbach's alpha. They include the cognitive bias constructs, decision-making constructs, cost overrun factors, and risk and decision-making constructs. Moreover, the investigation checked the reliability of the sub-instruments used in the research to ensure they yield consistent results and minimize errors. In the end, the reliability of each of the spheres described above is ranked to help in the discussion. Based on the outcomes obtained from the pilot test of 5 respondents, the results on Cronbach's alpha were tested on each construct to ensure they score above 0.7 or 70% which is recommended according to Schrag (1992). Results are presented in table 5.5 below.

Table 5.5: Cronbach Alpha Results

| Constructs Tested | Cronbach Alpha Ratio |
|---|---|
| Cognitive Bias | 0.76 |
| Decision making | 0.72 |
| Cost Overrun | 0.79 |
| Risk and Decision Making | 0.77 |

Source: (Author, 2019)

From the Cronbach Alpha results on table 5.5, it is established that each of the constructs scored above 0.70, an indication that all the items in the questionnaire were reliable, and the overall results will be acceptable as true representation of the results. However, Nissen (1985) notes that when a study is reliable does not imply that it is valid, and as such it is important to determine the validity of a study as explained below.

### *5.8.2 Validity*

In social science validity tend to refer to the content and internal validity of the research instrument. Internal validity addresses the issue that the research instrument is designed to measure what it is proposed to measure. Content validity was achieved by development the questionnaire statements based on the existing literature and by seeking the opining of professionals and the content of the statements and content of the questions. Construct validity was achieved through an extensive examination of the existing literature. Aside from ascertaining the validity of the questionnaire from existing research studies in the field, the study also takes note of constructs which display an illusion of validity to avoid making erroneous inferences. Different models hypothesizing how the constructs under investigation are related are used to further decide whether validity of the instrument has been achieved.

## *5.9 Nature and Source of Data*

Having established that the target population will be project managers on mega projects, it is utterly important to explain the nature and source of anticipated data. Ideally, the nature of anticipated data will be quantitative in nature following the decision to use a positivism philosophy, which provides for numeric data that can be statistically analysed. Further, the source of data will be primary sources, which will be gathered through surveys. As a results, a systematic approach will be used in which case structured instruments with closed ended questions will be distributed to potential respondents. Moreover, respondents will be contacted before, data instruments are sent out to seek their consent, and request them to respond objectively and honestly to the questions. This will also serve as an important opportunity for the researcher to assure them of their privacy. Finally, the researcher will adopt a multiple platforms to send and receive responses such as emails, phone calls, and physical delivery where possible.

### *5.10 Data Analysis*

Since the data is quantitative the several statistical tests are conducted to investigate the hypothesized relationships. Firstly, the responses from the questionnaire are tested for common bias using Harman's Single-Factor test that entails checking whether there exists a common method variance in the data. Evidently, the common method variance does not investigate the actual deviations in the data but rather the measurement instrument. Researchers note that inadequate acknowledgement of the common method bias in self-reports and questionnaires where the respondents act as single sources of information could lead to problematic inferences (Tehseen, et al., 2017). In contexts where information on independent and dependent variables is collected from the same respondents as is the case in this investigation, testing common bias is the key requirement to ensure reliability and validity of the responses. Additionally, respondents may introduce common method bias in a study to "social desirability" (Tehseen, et al., 2017). Another factor leading to the inclusion of common bias testing in this study is the prevalence of contextual errors arising when data is collected from respondents. In specific, Chan, Van Witteloostuijn and Eden (2010) argue that the placement of questions in a questionnaire and external influences such as location, media and time have often played a role in increasing the common method bias, thus, it is imperative to test for the construct before using the data.

Once the data has been adequately screened for common method bias, reliability tests follow to ensure that errors arising from inconsistencies in the research approach, the research instruments, and the research respondents are mitigated. All the decision-making constructs identified in the data collection section above are run through the Cronbach alpha test to determine their reliability and validity. This is particularly important for quantitative research that aims to be objective and reproducible. In specific, reliability quantifies the consistency of measure in research. By contrast, reliability checks whether the scores on a data collection tool adequately model the construct under investigation. Moreover, internal consistency serves to ensure the inferences presented in later sections are free of error and represent unbiased truth.

The actual analysis of the data collected from the study participants follows the reliability and validity tests. Like most studies, the first section details descriptive statistics followed by inferential statistics in later sections. The descriptive statistics check the demographic features of the sample under study to ensure a gender-balanced research sample. Moreover, other crucial variables that could affect decision making and cognitive bias such as location, working experience, and job position are also analysed to get a comprehension of how demography plays a role in the research questions. In addition, the ethnic alignment of the respondents is also checked to allow the further specification of notable findings related to different cultures. In addition to the analysis of the participant's personal information, descriptive statistics of the main variables under research follows. The main variables have been defined in the data collection section; however, additional sub-categorizations are made in each of the main variables to further increase the strength of the analysis. For instance, cost decision-making coded as DM is split into 16 components related to decision making and costs in mega projects.

Notably, a five-point Likert is used to collect responses from the respondents. Consequently, project risk and decision making are investigated alongside 20 components of the above constructs to ensure inclusivity. Again, a five-point Likert scale is used for the collection of responses on risk and decision making in mega projects. The influence of personality traits on decision making in mega projects in this study is measured against 12 traits identified by scholars as crucial components modelling cognitive bias in managers, CEOs and other stakeholders involved in mega projects. The final variable measures over optimism and decision making among individuals using five factors detailed in the analysis section.

The inferential statistics section seeks to answer the actual research questions and meet the research objectives presented in an earlier section. The aforementioned variables and hypotheses formulated in this investigation are also tested in this section. The analysis follows four phases where different types of statistical procedures with unique goals are adopted. ANOVA analysis is conducted, followed by hypothesis tests investigating the four main research variables; then association tests serving to resolve issues with the significance of the results, normality, and linearity. Consequently, hierarchical regression is adopted to check the combined influence of the variables and their multi-level relationships. The final set of analysis aims to check the significance of the findings and the relationships hypothesized between the constructs under investigation. A more detailed view of the results and analysis are presented in the imminent sections.

### *5.11 Ethical Foundations*

The topic of ethical practices in research is of paramount importance and cannot be overstated. It enables the researcher to compare findings to other studies, as well as making inferences to be accepted by other scholars. In this study, there are a number of ethical foundations that were followed to offer the entire process credibility. Firstly, the researcher ensured that there are efforts in place to seek consent from the respondents before the actual survey was carried out, so as not to coerce them to take part in the study. Secondly, the researcher ensured the standard of anonymity was strictly adhered to, by ensuring that no personal details of the respondents, their organisations, the specific projects, and contact information was captured in the instrument. This ensured that their privacy was upheld and respected, and also served as a strategy to encourage honest respondents as well as higher response rate.

Thirdly, the researcher sought to follow the guidelines on beneficence, in which the main focus was to ensure that participants benefited from the conduct of this study as opposed to harming them. This involved explaining to them the need of the study, and the aims the researcher wanted to achieve. Further, they were promised that the copy of the final process will be made available through publication, and a link sent to them so that they can access the outcomes. This was specifically important to help them in their managerial practices in ensuring that project performance is not hindered because of cognitive bias, by providing recommendations on the areas they can improve. Fourthly, the researcher ensured that ethical requirements of the university including but not limited to when conducting a study on human beings, need to acknowledge other people's ideas used in the study through proper referencing, and using the outcomes of the study for the intended purposes only were strictly followed.

*5.12 Chapter Summary*

In this chapter, a detailed explanation has been offered on the principles of methodological assumptions used in this study, guided by the overall philosophical choice. This has enabled the researcher to explicitly justify why the overall approach as on quantitative data as opposed to qualitative or both, by explaining that quantitative data reduces chances of interpretation bias, as well as making it possible to test the proposed hypotheses. Further, the chapter has presented detailed explanation on the statistical tools to be used in analysing data, as well as for pre-test exercise through reliability tests on Cronbach Alpha ratio. Moreover, this chapter has presented a detailed overview of the research instruments, data gathering process, sampling, and ethical foundations. The subsequent chapter will present findings for the study as obtained from the surveys that were carried out.

## Chapter Six: Analysis and Results

### *6.1 Introduction*

The study looked at the perception of various project stakeholders that included engineers, project managers, directors, CEO's and others to determine whether there is cognitive biasness on decision-making in mega projects primarily with regards to the project's costs involved. The section provides the analysis for the data collected from the questionnaire completed by various respondents. These are structured as follows.

First, the data was tested for common method bias to confirm that there are no variations in responses due to the questionnaire instrument but rather from the predispositions, the questionnaire intended to find. The data was then checked for reliability using Cronbach's alpha. Thirdly, descriptive statistics of all variables was examined to have an overview of the respondent's responses. The difference among the opinions of the respondents to the survey questions was analysed using ANOVA analysis by means of SPSS software. The study will further analyse the relationship between the dependent and independent variables using an association analysis. Lastly, the combined influence of using hierarchical regression will be tested.

### *6.2 Common Bias Testing*

Harman's Single-Factor test is used to test Common Method Variance in the collected data. In this study, all questionnaire items (with the exception of the demography data) were put into factor analysis in SPSS. The rotation method is indicated as (none). The output from the test is shown in table 4.1. The generated PCA output revealed 24 distinct factors accounting 80% (79.396) of the total variance. As shown in the table, the first un-rotated factor captured only 14% (13.109) of the variance in data. Thus, the results indicate that the test underlying conditions did not meet, i.e. no single factor emerged and the first factor did not capture most of the variance. Therefore, these test results support the evidence that Common Method Variance is not present in this research.

Table 4.1: Total variance explained

| Total Variance Explained | | | | | | |
|---|---|---|---|---|---|---|
| Component | Initial Eigenvalues | | | Extraction Sums of Squared Loadings | | |
| | Total | % of Variance | Cumulative % | Total | % of Variance | Cumulative % |
| 1 | 11.143 | 13.109 | 13.109 | 11.143 | 13.109 | 13.109 |
| 2 | 7.157 | 8.420 | 21.529 | 7.157 | 8.420 | 21.529 |
| 3 | 5.162 | 6.073 | 27.602 | 5.162 | 6.073 | 27.602 |
| 4 | 4.410 | 5.189 | 32.791 | 4.410 | 5.189 | 32.791 |
| 5 | 3.855 | 4.536 | 37.326 | 3.855 | 4.536 | 37.326 |
| 6 | 3.247 | 3.820 | 41.146 | 3.247 | 3.820 | 41.146 |
| 7 | 3.030 | 3.564 | 44.710 | 3.030 | 3.564 | 44.710 |
| 8 | 2.784 | 3.276 | 47.986 | 2.784 | 3.276 | 47.986 |
| 9 | 2.714 | 3.193 | 51.179 | 2.714 | 3.193 | 51.179 |
| 10 | 2.430 | 2.859 | 54.038 | 2.430 | 2.859 | 54.038 |
| 11 | 2.079 | 2.446 | 56.484 | 2.079 | 2.446 | 56.484 |
| 12 | 2.032 | 2.390 | 58.874 | 2.032 | 2.390 | 58.874 |
| 13 | 1.919 | 2.257 | 61.132 | 1.919 | 2.257 | 61.132 |
| 14 | 1.829 | 2.151 | 63.283 | 1.829 | 2.151 | 63.283 |
| 15 | 1.667 | 1.961 | 65.244 | 1.667 | 1.961 | 65.244 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 16 | 1.611 | 1.895 | 67.139 | 1.611 | 1.895 | 67.139 |
| 17 | 1.587 | 1.867 | 69.006 | 1.587 | 1.867 | 69.006 |
| 18 | 1.460 | 1.718 | 70.724 | 1.460 | 1.718 | 70.724 |
| 19 | 1.421 | 1.671 | 72.395 | 1.421 | 1.671 | 72.395 |
| 20 | 1.308 | 1.539 | 73.934 | 1.308 | 1.539 | 73.934 |
| 21 | 1.272 | 1.497 | 75.431 | 1.272 | 1.497 | 75.431 |
| 22 | 1.212 | 1.426 | 76.857 | 1.212 | 1.426 | 76.857 |
| 23 | 1.088 | 1.280 | 78.137 | 1.088 | 1.280 | 78.137 |
| 24 | 1.070 | 1.259 | 79.396 | 1.070 | 1.259 | 79.396 |
| 25 | .987 | 1.161 | 80.557 | | | |

Source: Created on SPSS using respondent's survey data

*6.3 Reliability Test Results*

Reliability, validity and credibility are the most important part of a research. To minimize the risk of the different errors that arise during research data analysis, it is needed to consider important issues including the validity and reliability. Reliability is linked to the results indicating that they are reliable if the research is conducted more than once. It is related to the examination of the consistency among different findings. Validity and reliability both are considered the important part of any questionnaire. For fulfilling the reliability, there are different techniques that are available like Cronbach's Alpha. Reliability is usually calculated in the range 0-1 where 1 is reliable while 0 is not. A value, which is greater than 0.75 and 0.9, is good and perfect respectively but less than 0.75 is poor. Reliability tests were conducted using Cronbach's Alpha test. For this research, reliability tests were conducted for:

- Decision-making constructs

- Risk & decision-making constructs
- Cognitive biases constructs
- Project cost overrun constructs

Several Cronbach's Alpha tests were conducted to test the reliability of this research instruments. The reliability estimate of the entire cognitive base set of instruments was 0.847. The reliability estimate of the whole set of the research instrument was 0.772. Also, reliability test was carried for each of the sub-instruments. Results are shown in table 4.2 – 4.43 in appendix section.

The scale for decision-making construct consisted of 16 statements denoted by DM1 - DM16. Construct DM4 was removed due to reliability. The results indicated ($\alpha$=0.702). For risk and decision-making, 20 questions denoted by R1 - R20 were analyzed. The results obtained ($\alpha$=0.909) which is perfect. For cognitive biases constructs, represented by Personality t1 - t12, the results indicated Personality t1 ($\alpha$=0.606), Personality t2 ($\alpha$=0.604), Personality t3 ($\alpha$=0.549), Personality t4 ($\alpha$=0.720) construct CN5 deleted, Personality t5 ($\alpha$=0.815), Personality t6 ($\alpha$= 0.611) construct D4 deleted, Personality t7 ($\alpha$=0.538) construct F2 deleted, Personality t8 ($\alpha$=0.456) item deleted, Personality t9 ($\alpha$=0.117) item deleted, Personality t10 ($\alpha$=0.124) item deleted, Personality t11 ($\alpha$ =0.815) construct O3 deleted, Personality t12 ($\alpha$= 0.692) construct V2 deleted. The scale for project cost overrun indicated ($\alpha$=0.758). The Cronbach alpha for the 4 groups was reliable. Three of the personality groups attained less reliability. Table 4.44 below provides the summary.

Table 4.44: Summary of reliability results

| Group | No. of items | Cronbach Alpha | Ranking of reliability |
|---|---|---|---|

| | | | |
|---|---|---|---|
| Decision-making construct | 15 | 0.702 | 4th |
| Risk & Decision-making | 20 | 0.909 | 1st |
| Personality t1 to personality t12 | 31 | 0.606, 0.604, 0.549, 0.720, 0.815, 0.611, 0.538, 0.456, 0.117, 0.124, 0.815, 0.692 | 2nd (0.847) |
| Project cost overrun | 5 | 0.758 | 3rd |

Source: Created by student on MS Excel

*6.4 Descriptive Statistics*

*6.4.1 Participant's general information*

*Gender*

Figure 1 below shows the information regarding the gender of the participants.

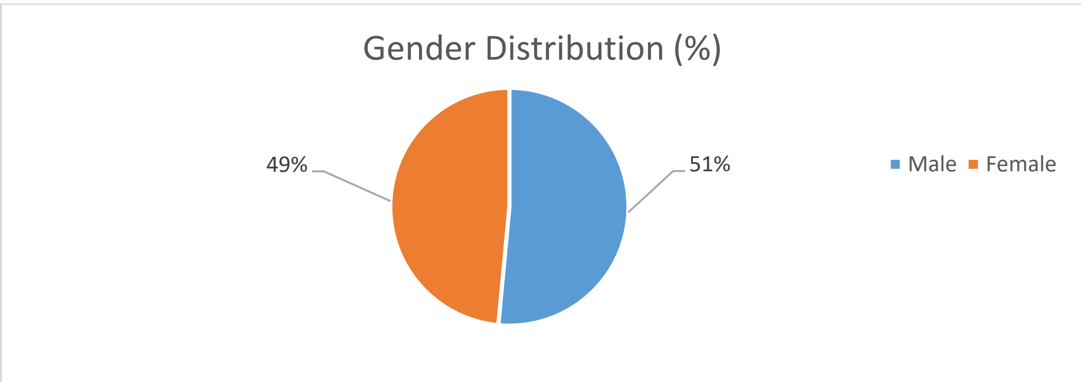


Figure 1: Respondent's gender distribution

Source: Created by student on MS Excel.

According to the table, there are 52 males (51.5%) and 49 females (48.5%) in the sample. The total number of participants was 101. These results show the responses were nearly equal in terms of gender hence the findings in this study will not sway towards the preconception of gender.

*Culture*

This part focuses on the cultural background of the participants. 33 participants were Americans (32.7%), 60 participants belonged to the Middle Eastern countries (59.4%), whereas 5 participants were from Europe (5.0%), 2 from Africa (2.0%) and 1 participant from Asia (1.0%). The total number of participants is 101. The results indicate the sample represented a diversified culture. Figure 2 below shows the distribution.

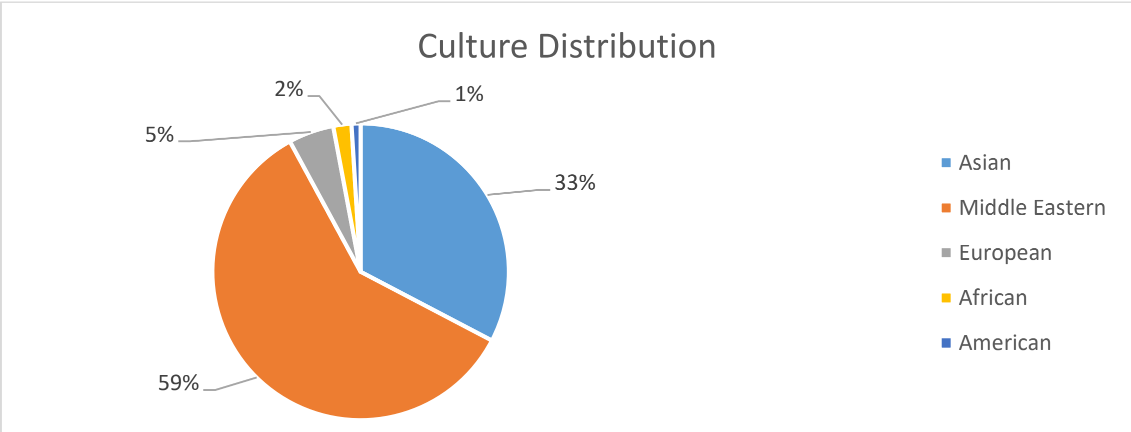


Figure 2: Respondent's culture distribution

Source: Created by student on MS Excel.

*Company size*

This part is based on the number of employees working in an organization. 51 people who are working in organization having employees less than 300 are involved (50.5%), whereas the participants belonging from the organizations having employees from 301 to 999 are 14 (13.9%). The participants belonging from the organization having employees from 1000 to 3000 are 13 (12.9%) where participants from the organizations having employees above that are 23 (22.8%). The results show the findings of the study are applicable to all company sizes as the sample was obtained from a varied company sizes. Figure 3 below displays the distribution.

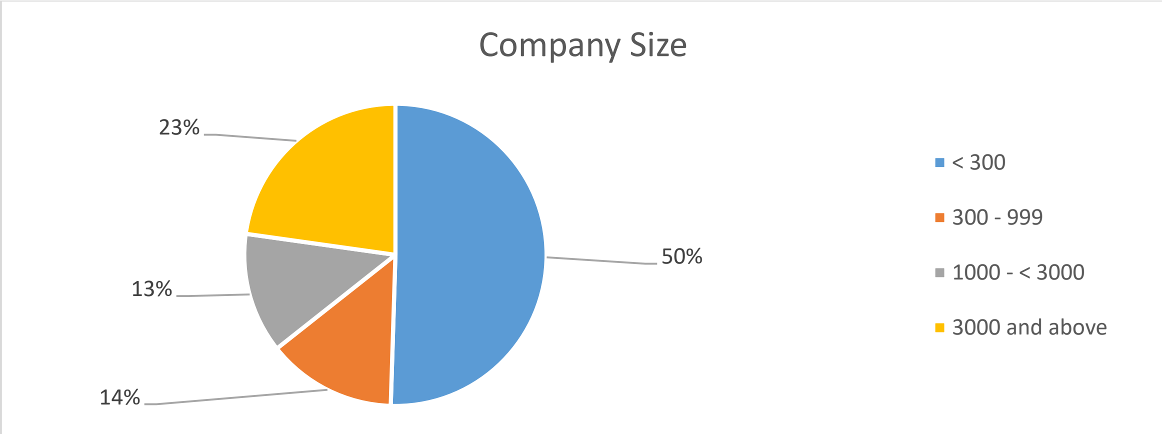


Figure 3: Respondent's company size

Source: Created by student on MS Excel.

*Work experience*

Based on experience of work, the participants who took part in the survey with work experience between 0 and 2 years are 19 (18.8%), whereas the participants having experience from 3 to 5 years are 14 (13.9%). There are 19 participants having experience from 6 to 10 years (19%), 35 participants are those who have experience from 11 to 19 years and the participants who have experience 20 years and above are 14 (13.9%). Total number of participants is 101. The results show the views portrayed in this study incorporates perceptions of employees with diverse extent of work experience, that is, those with minimal experience (0 – 2 years) to those who are highly experienced (20 years and above). Figure 4 below displays the distribution.

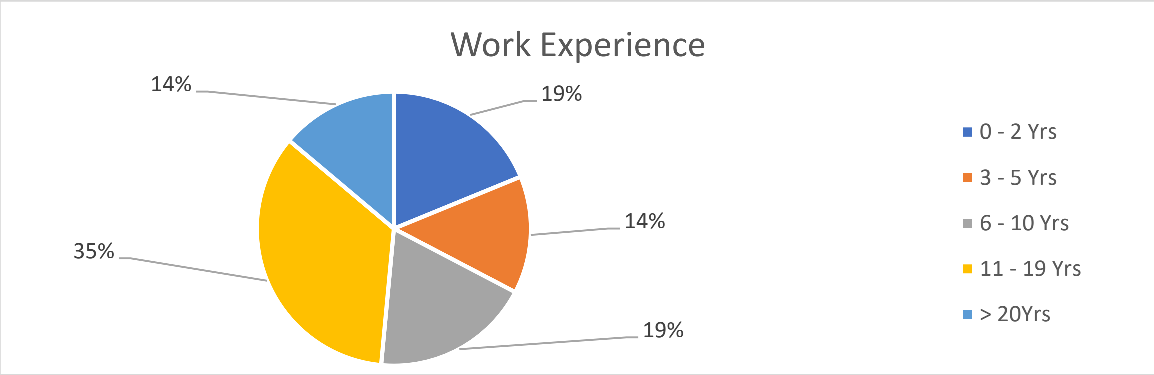


Figure 4: Respondents work experience distribution

Source: Created by student on MS Excel.

*Job position*

On the basis of job position, 21 participants were engineer (20.8%), 12 were project managers (11.9%), 20 participants were the directors of different organizations (19.8%) and 5 participants were the CEO (5.0%). 43 participants belonged to other positions (19.8%).Total number of participants are 101.The result show the findings will represent a general view of professionals who are the main stakeholders in projects (engineer, project manager, director, CEO) and those who are not (Others). Figure 5 below shows distribution.

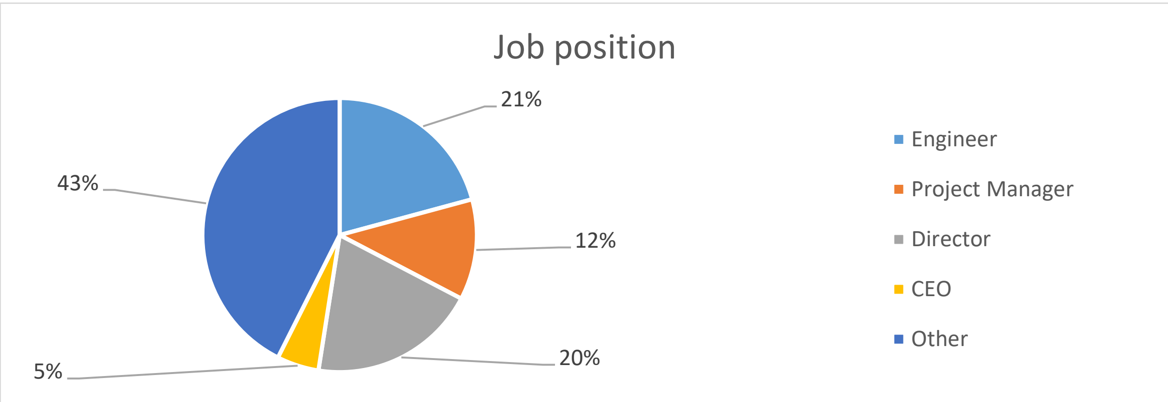


Figure 5: Respondents job position distribution

Source: Created by student on MS Excel.

*6.4.2 Descriptive statistics for main variables*

The descriptive statistics for the 12 cognitive biases variables, cost decision-making variable, risk decision-making variable, and cost overrun due to over optimism variable was evaluated by consolidating the responses for each variable based on the 5-point Likert scale as adopted on the questionnaire.

*Costs decision-making in mega projects (DM)*

Cost decision-making variable was analysed using 16 constructs (DM1 – DM16). In order to check whether overall decision-making has an impact in mega projects costs, the study combined the measurements for the 16 constructs based on the 5-point Likert scale as used on the questionnaire where, ‘1’ represented ‘Very Likely’, ‘2’ represented ‘Likely’, ‘3’ represented ‘Neutral’, ‘4’ represented ‘Unlikely’ and ‘5’ represented ‘Very Unlikely’. The respondents have shown that the decision-making is likely to influence mega projects costs.23 (23%) respondents said that it will be very likely to influence the megaprojects costs. 66 (65%) respondents selected the option of likely, 10 (10%) respondents remained neutral and the remaining selected unlikely, and none selected very unlikely. Figure 6 below shows the chart. The results indicate decision-making is an important element in mega projects costs.

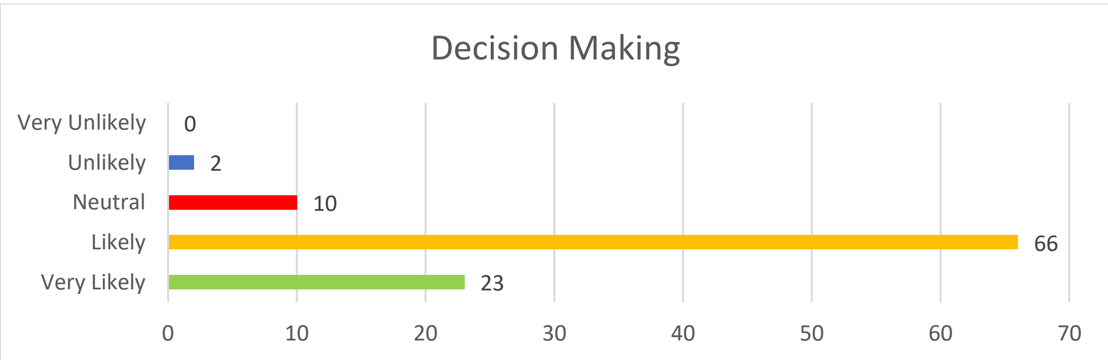


Figure 6: Descriptive statistics for DM variable

Source: Created by student-using respondent’s survey data

*Project risk decision-making in mega projects*

Risk decision-making variable was analysed using 20 constructs (R1 – R20). To check whether overall risk decision-making is important in mega projects, the study combined the measurements for the 20 constructs based on the 5-point Likert scale as applied on the questionnaire where, '1' represented 'Very Likely', '2' represented 'Likely', '3' represented 'Neutral', '4' represented 'Unlikely' and '5' represented 'Very Unlikely'. The results showed 52 (51.5%) respondents indicated that it is likely to consider risk decision-making in mega projects. 33(32.7%) respondents selected very likely, 15(14.8%) were neutral, 1(1%) respondent selected unlikely, and none chose it very unlikely to consider risk decision-making in mega projects. The results indicate risk decision-making is an important element in megaprojects.

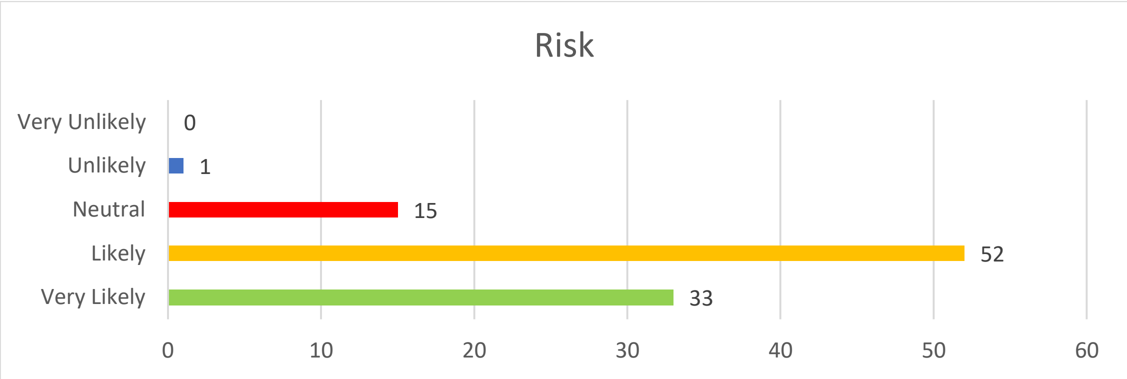


Figure 7: Descriptive statistics for risk variable

Source: Created by student-using respondent's survey data

*Personality traits on cost decisions*

Personality traits that reflected the various cognitive biases was looked at in terms of 12 factors namely controllability, availability, anchoring, conformation, cognitive dissonance, dread, familiarity, hindsight, scale, representativeness, optimism, and venturesomeness. Each factor had a different number of item constructs as shown in the analysis sections. To analyse whether each personal trait had an influence in decision-making a consolidated figure for each trait was examined based on the 5-point Likert scale as formulated in the questionnaire where '1' represented 'Strongly Disagree', '2' represented 'Disagree', '3' represented 'Undecided, '4' represented 'Agree', and '5' represented 'Strongly Agree'

*Controllability*

Controllability is the factor that might affect the process of the decision-making and 67(66.3%) respondents agreed to this statement, 5 (5%) strongly agreed and 21 (20.8%) were neutral indicating that it was a strong variable. 2 (2%) selected strongly disagree and 6 (5.9%) selected disagree. The results show that controllability influences decision-making.

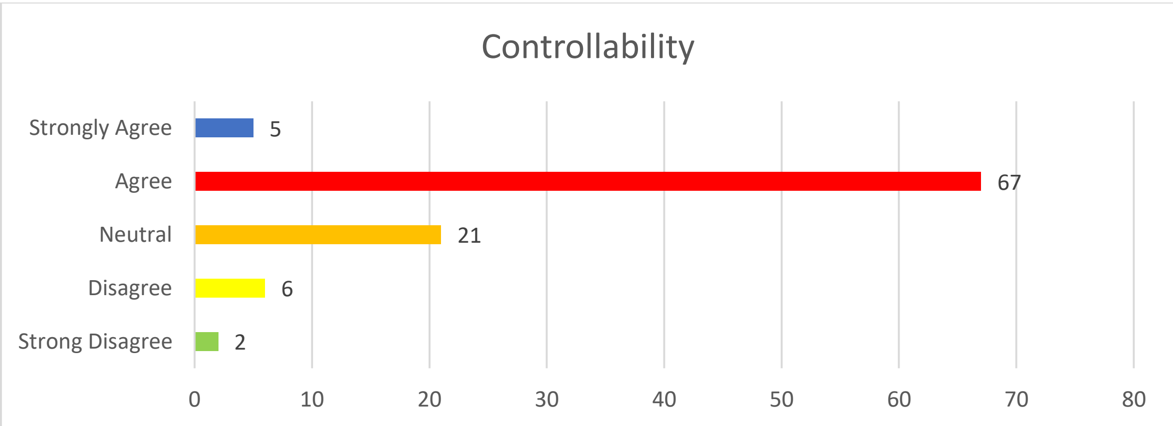


Figure 8: Descriptive statistics for controllability on decision-making

Source: Created by student-using respondent's survey data

*Availability*

For availability 71 (70.3%) respondents agreed that it influences the decision-making process and few were those who didn't agree to this point thus indicating that it is a strong factor. 10 (9.9%) selected disagree, 5 (5%) selected neutral, and 15 (14.9%) selected strongly agree. The results indicate availability has high influence on decision-making.

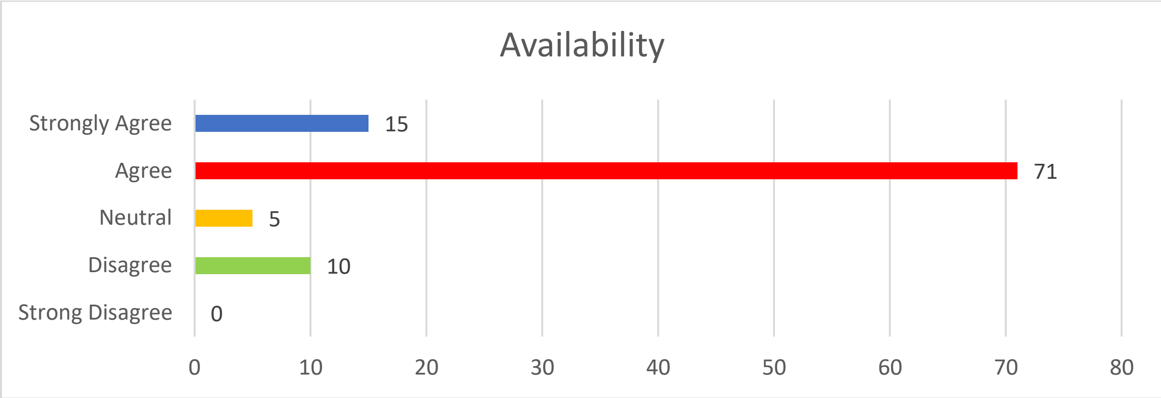


Figure 9: Descriptive statistics for availability on decision-making

Source: Created by student-using respondent's survey data

*Anchoring*

72 (71.3%) respondents agreed, 13 (12.9%) were neutral and 6 (5.9%) strongly agreed that anchoring was an important variable for the decision-making, 8 (7.9%) disagreed, and 2 (2%) strongly disagreed. The results show anchoring is a strong factor in influencing decision-making. Figure 10 below shows this distribution in responses.

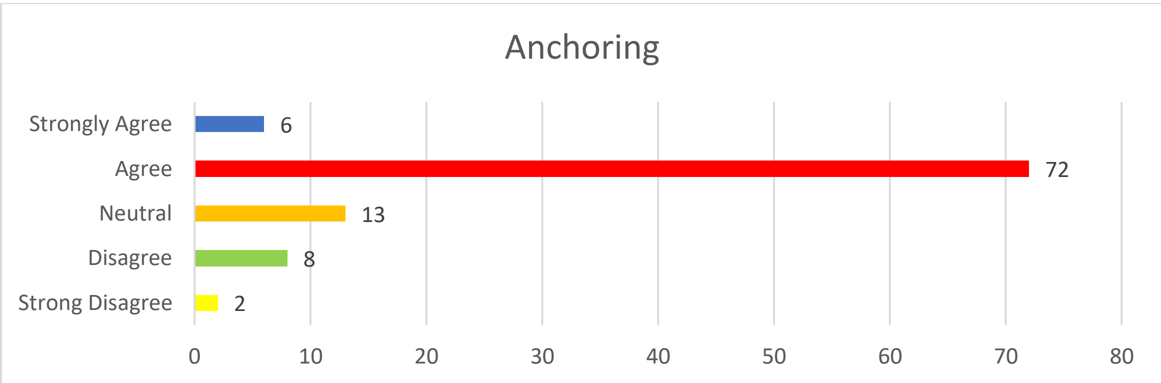


Figure 10: Descriptive statistics for anchoring on decision-making

Source: Created by student-using respondent's survey data

*Conformation*

79 (78.2%) respondents agreed that conformation has an influence on decision-making in mega projects, 8 (7.9%) strongly agreed, 7 (6.9%) were neutral, 6 (5.9%) disagreed, and only 1 (1%) respondent strongly disagreed. The result indicates

conformation is a strong factor in determining decision-making in mega projects. Figure 11 below displays the descriptive statistics.

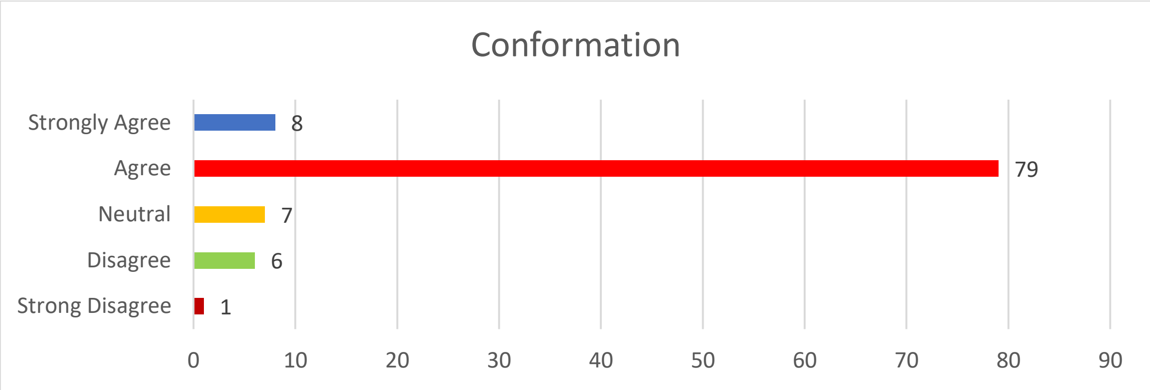


Figure 11: Descriptive statistics for conformation on decision-making

Source: Created by student-using respondent's survey data

*Cognitive dissonance*

Cognitive dissonance is not a very string factor as it indicated different responses including 32 (31.7%) for agree, 3 (3%) for strongly agree, 27 (26.7%) for neutral, 35 (34.7%)for disagree and 4 (4%) for strongly disagree. The results show cognitive dissonance is neither important nor not important in influencing decision-making in mega projects. Figure 12 below represents the divide in responses for this factor.

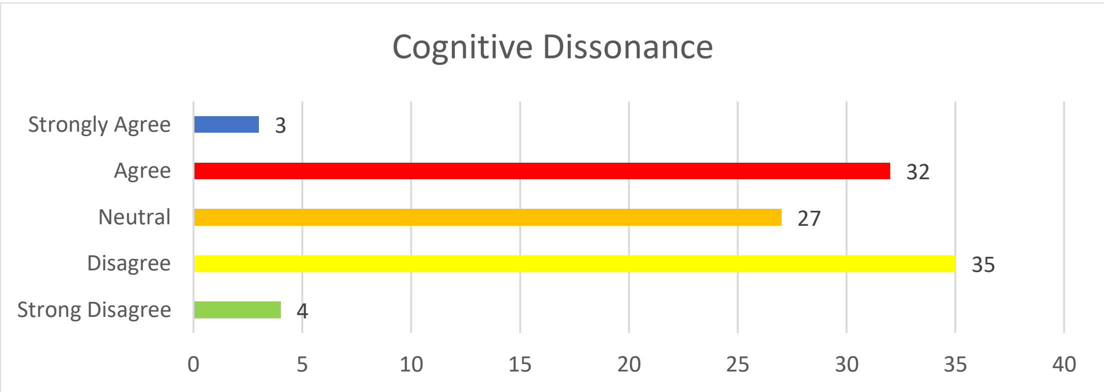


Figure 12: Descriptive statistics for cognitive dissonance on decision-making

Source: Created by student-using respondent's survey data

*Dread*

The results indicated that dread is the factor that got mix type of responses with 42 (41.6%) agree, 23 (22.8%) were neutral and 30 (29.7%) disagree. 4 (4%) selected strongly disagree and 2 (2%) selected strongly agree. The results indicate the dread factor influences decision-making marginally (Figure 13 below).

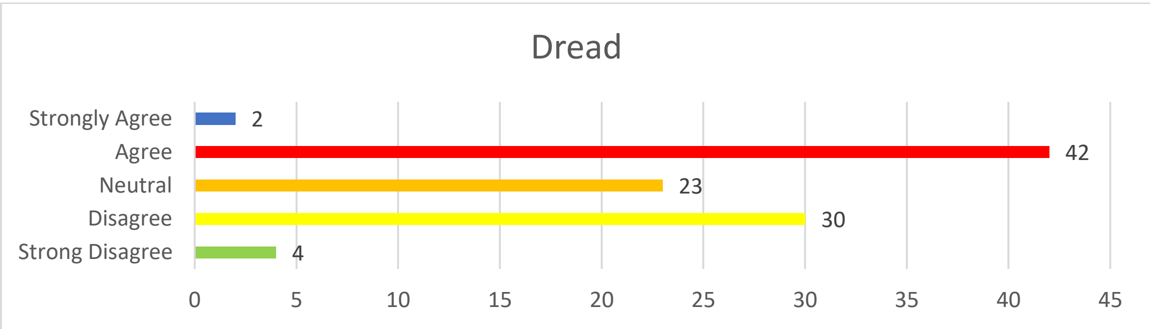


Figure 13: Descriptive statistics for dread factor on decision-making

Source: Created by student-using respondent's survey data

*Familiarity*

The results indicated that familiarity is the factor that influences the process of decision-making in the mega projects. 7 (6.9%) respondents selected disagree, 10 (9.9%) selected neutral, 77 (76.2%) selected agree and 6 (5.9%) selected strongly agree. 1 (1%) respondent strongly disagreed. The results (Figure 14 below) show familiarity is a strong factor in influencing decision-making.

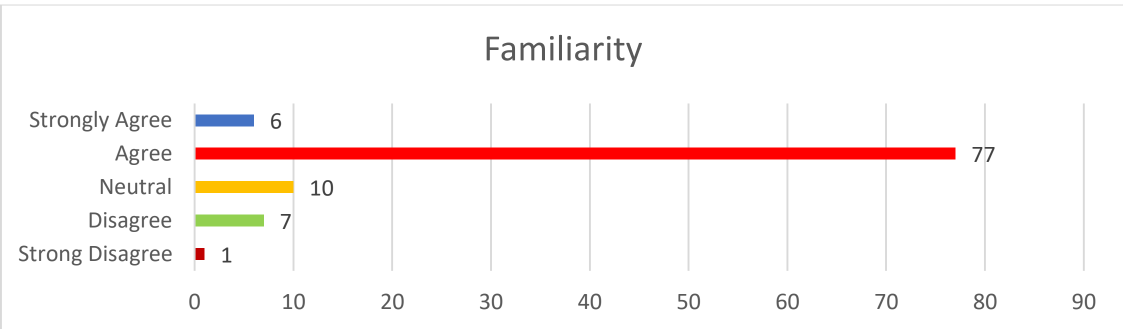


Figure 14: Descriptive statistics for familiarity factor on decision-making

Source: Created by student-using respondent's survey data

*Hindsight*

The results just shown that hindsight influences the overall decision-making process and most of the respondents agreed to it. 1 (1%) person selected strongly agree, 12 (11.9%) people selected disagree, 19 (18.8%) selected neutral, 68 (67.3%) selected agree and 1 (1%) selected strongly agree (Figure 15 below). The results indicate hindsight is an important element in influencing decision-making.

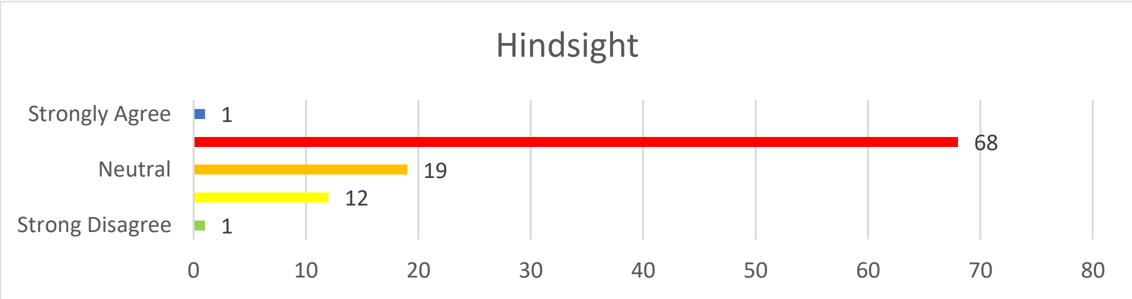


Figure 15: Descriptive statistics for hindsight factor on decision-making

Source: Created by student-using respondent's survey data

*Scale*

Most of the respondents agreed that scale might influence the process if decision-making in mega projects. 45 (44.6%) respondents agreed to it, 1 (1%) selected strongly agree, 33 (32.7%) selected neutral, 21 (20.8%) selected disagree and 1 (1%) selected strongly disagree (Figure 16 below). The results indicate scale factor has an impact on decision-making.

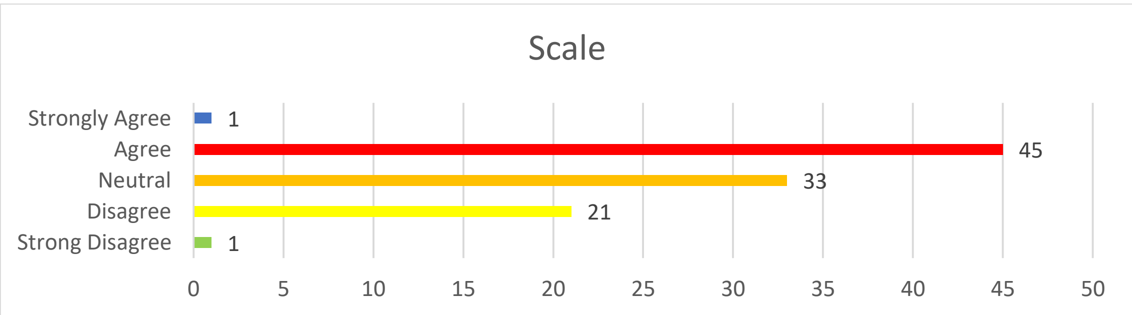

Figure 16: Descriptive statistics for scale factor on decision-making

Source: Created by student-using respondent's survey data

*Representativeness*

For the representativeness, most of the positive responses were seen and some of the respondents disagree to that. 1 (1%) selected strongly disagree, 10 (9.9%) selected disagree, 45 (44.6%) selected neutral, 44 (43.6%) selected agree, 1 (1%) selected strongly agree (Figure 17 below).The results show representativeness has marginal influence on decision-making in mega projects.

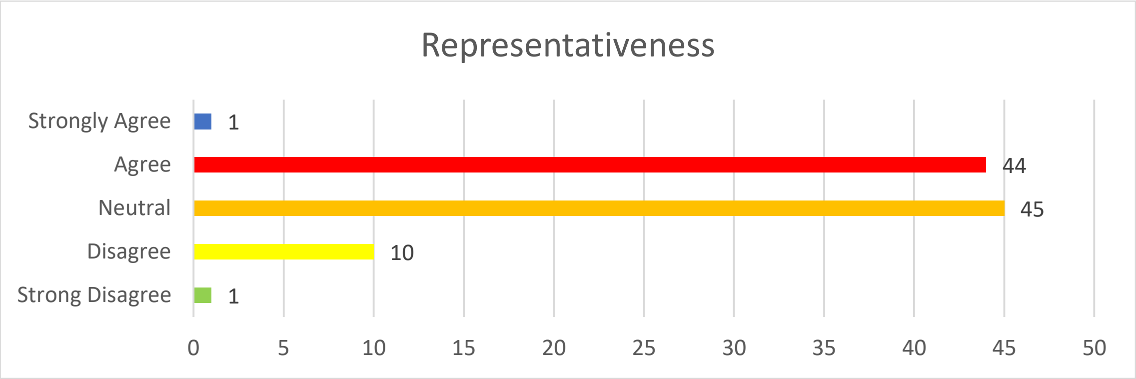


Figure 17: Descriptive statistics for representativeness factor on decision-making

Source: Created by student-using respondent's survey data

*Optimism*

Optimism is the factor that got mix responses, some respondents think that it influences their decision-making while some are neutral and some think that it does not impact the decision-making. None selected strongly disagree, 23 (22.8%) selected disagree, 25 (24.8%) selected neutral, 52 (51.5%) selected agree, 1 (1%) selected strongly agree (Figure 18 below). The results indicate optimism influences decision-making in mega projects.

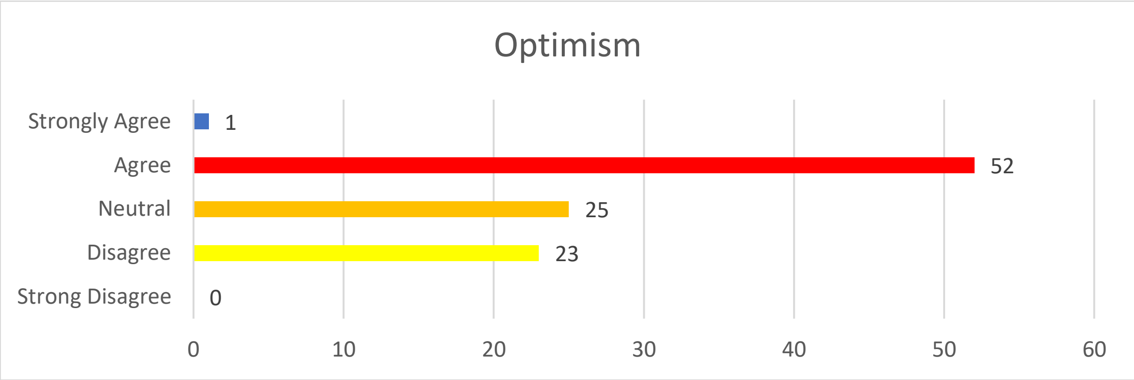


Figure 18: Descriptive statistics for optimism factor on decision-making

Source: Created by student-using respondent's survey data

*Venturesomeness*

Venturesomeness mainly influences the overall process of the decision-making according to the respondents. None strongly disagreed, 5 (5%) selected disagree, 20 (19.8%) selected neutral, 71 (70.3%) selected agree, 5 (5%) selected strongly agree (Figure 19 below).

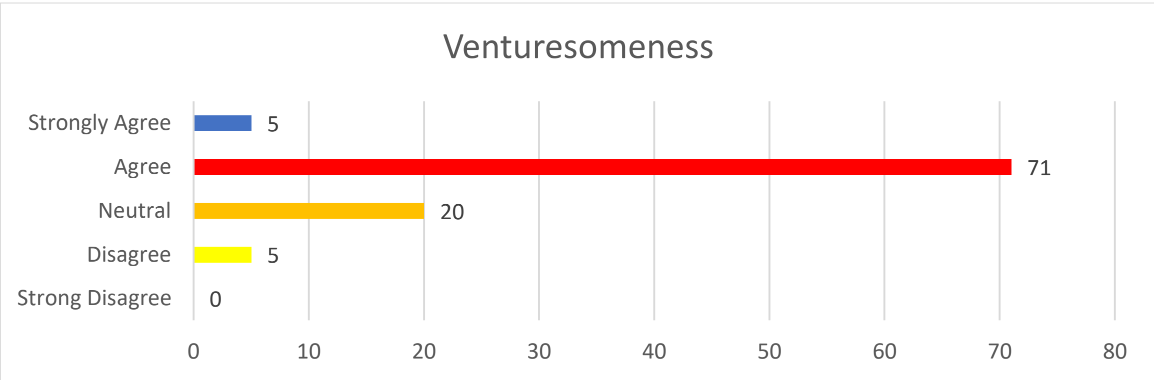


Figure 19: Descriptive statistics for venturesomeness factor on decision-making

Source: Created by student-using respondent's survey data

*Over optimism factors contributing to project cost overrun*

The extent of five over optimism factors on cost overrun was checked on a 5-point scale such that the extent of each factor was rated as less the 5%, 10%, 15%, 20%, or more than 20%.

*Overoptimistic forecasts of project budget*

The respondents showed diverse views regarding the effect of overoptimistic forecasts of project budget on project cost overrun. 42% respondents noted that the effect is at 15%, 18% respondents stated it is at 10%, 22% said it is less than 5%, 13% of them noted the effect is at 20%, and 5% indicated the effect is more than 20% (Figure 20 below). The results indicate that the effect of overoptimistic forecasts of project budget on project cost overrun ranges less than 15%.

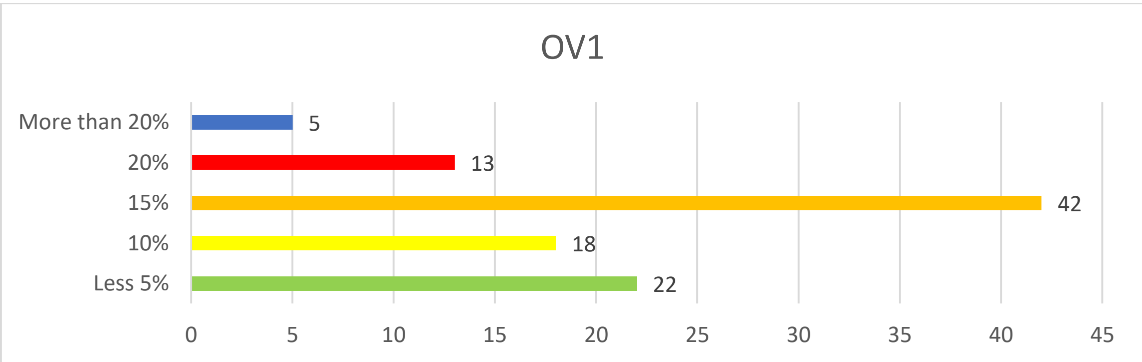


Figure 20: Overoptimistic forecasts of project budget on project cost overrun.

Source: Created by student-using respondent's survey data

*Egocentric interpretation of project scope*

Majority of respondents indicated egocentric interpretation of project scope impacts on project cost overrun by less than 15%. 14 (13.9%) respondents expressed the effect is more than 20%, 16 (15.8%) noted the effect is at 20%, 35 (34.7%) indicated it is at 15%, 23 (22.8%) noted it is at 10% and the rest indicated it is at less than 5% (Figure 21 below).

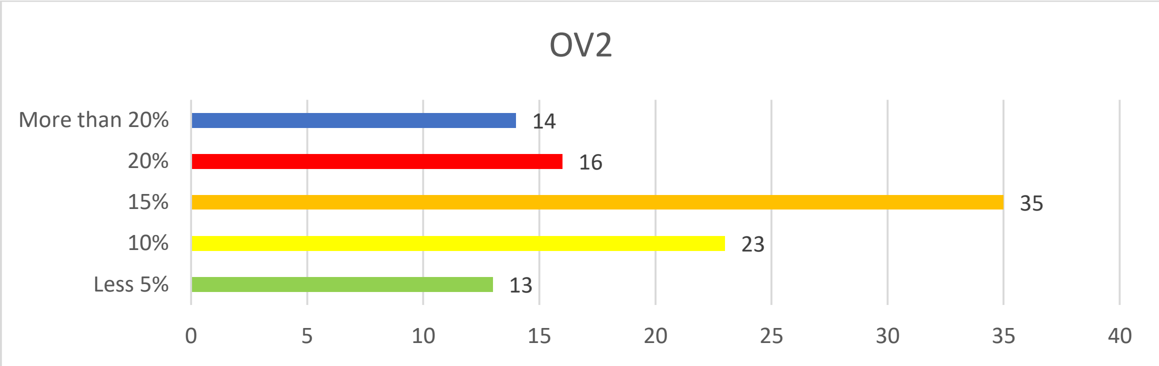


Figure 21: Egocentric interpretation of project scope on project cost overrun.

Source: Created by student-using respondent's survey data

*Cognitive delusion about project scope*

Many of the respondents indicated cognitive delusion about project scope has an effect of 15% on the project's cost overrun at 34 (33.7%), 18 (17.8%) of them indicated it is at 20%, 15 (14.8%) noted it is at more than 20%, 14 (13.9%) at 10% and 20 (19.8%) at less than 5% (Figure 22 below).

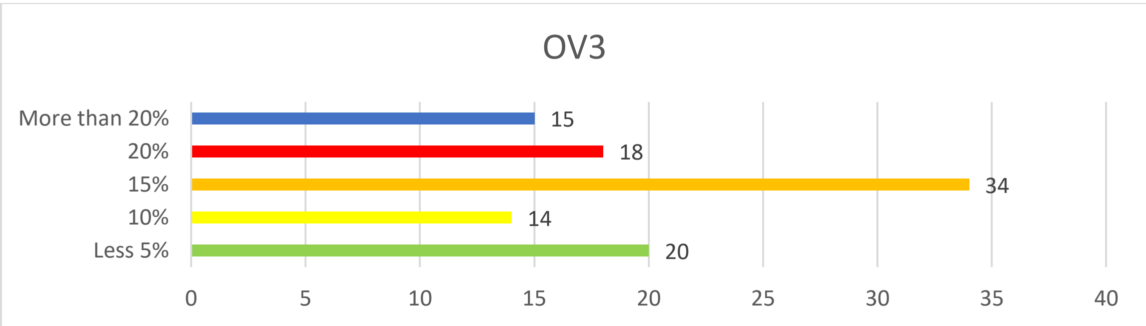


Figure 22: Cognitive delusion about project scope on project cost overrun

Source: Created by student-using respondent's survey data

*Misplaced incentives about project return*

This factor showed many respondents perceived it to have a high impact on project cost overrun. 20 (19.8%) noted the effect of misplaced incentives about project return on project cost overrun is above 20%, 34 (33.7%) indicated it is at 20%, 20

(19.8%) indicated it is at 15%, 10 respondents noted it is at 10%, and 17 noted it is less than 5%.

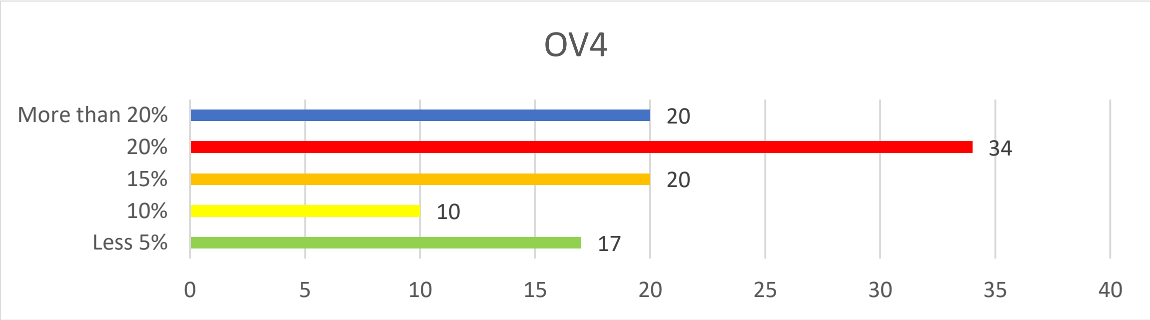


Figure 23: Misplaced incentives about project return on project cost overrun

Source: Created by student-using respondent's survey data

*Desirability of a positive project outcome*

The results indicated the desirability in having a positive project outcome raises the magnitude of the project's cost overrun. 20 (19.8%) respondents noted the effect is more than 20% on cost overrun, 34 (33.7%) noted the effect is at 20%, 20 (19.8%) indicated it is at 15%, 10 (9.9%) respondents selected the effect is at 10%, and 17 (16.8%) selected less than 5% effect on project cost overrun.

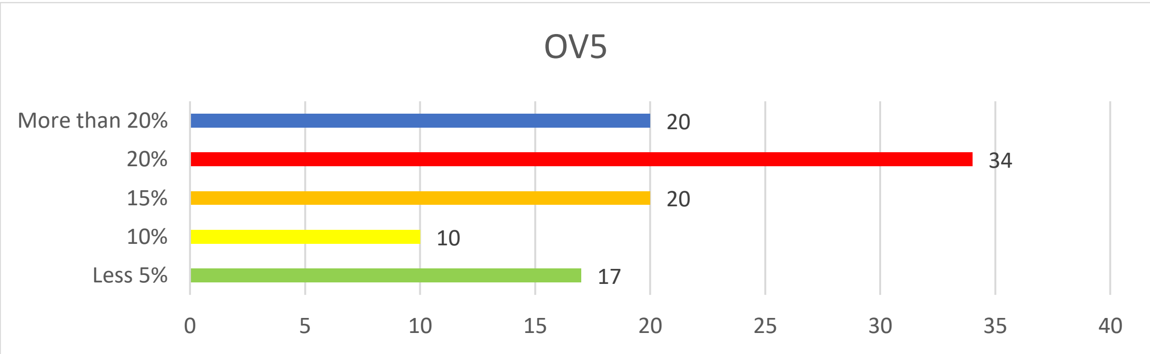


Figure 24: Desirability of a positive project outcome on project cost overrun

Source: Created by student-using respondent's survey data

*6.5 Variance Analysis Using ANOVA*

Numerous ANOVA tests were performed to examine the statistical differences of the groups' responses. According to Sounderpandian (2008), ANOVA is "used for determining the existence of differences among several population means because it can detect any differences between several population means by simply undertaking an analysis of the different sets of variance associated with random sample". The method used in this study is consistent with Moore (2010). The author suggested that to perform an overall assessment to check for evidence if there are any differences among the parameters of the groups who subject to comparison. If there were evidence then a detailed follow-up analysis should be undertaken to find where the difference comes from. To do so several hypotheses between the participants were tested.

*6.5.1 Hypothesis testing*

Following Moore (2010) and Filed (2016), this research formulated the hypotheses shown in table 4.45 below.

Table 4.45: Main hypothesis for the study

**Restatement of Research Hypotheses**

**1- Cost Decision-making Factors in Mega Projects**

| | | |
|---|---|---|
| 1 | $H_0 1$ | There is no statistically significant difference between the respondents' perceptions on ***'cost decision-making in Mega projects based on knowledge, experience and culture'***. |
| | $H_A 1$ | There is statistically significant difference between the respondents' perceptions on ***'cost decision-making in Mega projects based on knowledge, experience and culture'***. |

**2- Risk Factors Related to Decision-making in Mega Projects**

| | | |
|---|---|---|
| 2 | $H_0 2$ | There is no statistically significant difference between the respondents' perceptions on ***'project risk factors in mega projects based on knowledge, experience and culture'.*** |

$H_A2$ There is statistically significant difference between the respondents' perceptions on ***'project risk factors in mega projects based on knowledge, experience and culture'.***

**3- Personality Traits Related to Project Cost Decision-making**

3 $H_03$ There is no statistically significant difference between the respondents' perceptions on ***'personality traits that influence project cost decisions based on knowledge, experience and culture'.***

$H_A3$ There is statistically significant difference between the respondents' perceptions on ***'personality traits that influence project cost decisions based on knowledge, experience and culture'.***

**4- Factors Contributing to Project Cost Overrun**

4 $H_04$ There is no statistically significant difference between the respondents' perceptions on ***'factors contributing to project cost overrun based on knowledge, experience and culture'.***

$H_A4$ There is statistically significant difference between the respondents' perceptions on ***'factors contributing to project cost overrun based on knowledge, experience and culture'.***

**5- Cognitive Biases and cost overrun**

$H_05$ There is no statistically significant relationship between cognitive biases ***(controllability, availability, anchoring, confirmation, cognitive dissonance, dread, familiarity, optimism and venturesomeness) and 'the effect of over optimism on cost overrun'.***

$H_A5$ There is statistically significant relationship between cognitive biases ***(controllability, availability, anchoring, confirmation, cognitive dissonance, dread, familiarity, optimism and venturesomeness) and the effect of over optimism on cost overrun'.***

**6- Decision making and cost overrun**

$H_0$6 There is statistically significant relationship between ***decision-making (cost and risk) and 'the effect of over optimism on cost overrun'.***

$H_A$6 There is no statistically significant relationship between ***decision making (cost and risk) and the effect of over optimism on cost overrun'.***

**7- Cognitive Biases and Cost decision making in Mega Projects**

$H_0$7 There is no statistically significant relationship between cognitive biases ***(controllability, availability, anchoring, confirmation, cognitive dissonance, dread, familiarity, optimism and venturesomeness) and 'cost decision making in mega projects'***

$H_A$7 There is statistically significant relationship between cognitive biases ***(controllability, availability, anchoring, confirmation, cognitive dissonance, dread, familiarity, optimism and venturesomeness) and 'cost decision making in mega projects***

Source: Created by student to reach aim of study

ANOVA analysis was applied in the study to determine whether there is a difference among the respondents' perceptions on the factors under investigation. SPSS software was used to analyse the response data where a significance value of 0.05 was applied in the ANOVA test and the p-value for each of the item constructs was checked. The null hypotheses were rejected when the p-value was below 0.05 value. Results of each analysis are clarified in the subsequent sections. For each of the four main hypotheses, three secondary hypotheses were checked individually based on knowledge, experience and culture.

*6.5.2 Cost decision-making in mega projects*

15 item constructs were analysed in this section after one item namely, DM4 was eliminated.

*Based on job holder*

Results of the ANOVA analysis as shown in Table 4.46 in the appendix section indicated that among the 15 items, two items denoted by DM6 and DM10 were found to show statistical difference in perception among the respondents as shown in Table 4.47 below while the rest indicated no statistical difference.

Table 4.47: Rejected hypothesis

| | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| DM6 | Between Groups | 6.036 | 4 | 1.509 | 2.736 | .033 |
| | Within Groups | 52.954 | 96 | .552 | | |
| | Total | 58.990 | 100 | | | |
| DM10 | Between Groups | 8.036 | 4 | 2.009 | 3.702 | .008 |
| | Within Groups | 52.103 | 96 | .543 | | |
| | Total | 60.139 | 100 | | | |

Source: Table obtained from SPSS output

For the two items in Table 4.47 above, further scrutiny was undertaken using the Tukey test as the honest significant difference (HSD) test to evaluate the differences in means between the respondents and the results are as shown in Table 4.46 on the appendix section. For the DM6 item, the Tukey test indicated no significant difference in opinion was observed among engineers, project manager and CEO with the other respondents but a significant difference between the perception of directors and others was noted. For the DM10 item, the Tukey test indicated no significant difference in opinion was observed among directors, project manager and CEO with the other respondents but a significant difference between the perception of engineers and others was seen.

*Based on experience*

Table 4.48 in the appendix section provides the ANOVA analysis based on experience for the cost decision-making factors in mega projects.14 out of 15 items constructs were found to have no significant differences between the respondents with one item construct, DM1, showing statistical difference as shown in Table 4.49 below.

Table 4.49: Rejected hypothesis

| | | ***Sum of Squares*** | ***df*** | ***Mean Square*** | ***F*** | ***Sig.*** |
|---|---|---|---|---|---|---|
| ***DM1*** | ***Between Groups*** | 7.718 | 4 | 1.930 | 2.484 | .049 |
| | ***Within Groups*** | 74.579 | 96 | .777 | | |
| | ***Total*** | 82.297 | 100 | | | |

Source: SPSS output

Item construct DM1 was further checked using the Tukey test to identify where the differences arises and Table 4.50 below indicates that the differences in opinion is between respondents with over 20 years and those between 3 and 5 years, the rest had similar perception of DM1 item construct.

Table 4.50: Post Hoc tests

| Multiple Comparisons | | | | | | | |
|---|---|---|---|---|---|---|---|
| ***Tukey HSD*** | | | | | | | |
| ***Dependent Variable*** | | | ***Mean Difference (I-J)*** | ***Std. Error*** | ***Sig.*** | ***95% Confidence Interval*** | |
| | | | | | | ***Lower Bound*** | ***Upper Bound*** |
| ***DM1*** | ***3 - 5 Years*** | ***0 - 2 Years*** | -.583 | .310 | .337 | -1.45 | .28 |
| | | ***6 - 10 Years*** | -.425 | .310 | .649 | -1.29 | .44 |
| | | ***11 - 19 Years*** | -0.35714 | .279 | .703 | -1.13 | .42 |
| | | ***20 Years or Above*** | -1.000* | .333 | .028 | -1.93 | -.07 |
| | ***20 Years or Above*** | ***0 - 2 Years*** | 0.417293 | .310 | .664 | -.45 | 1.28 |
| | | ***3 - 5 Years*** | 1.000* | .333 | .028 | .07 | 1.93 |
| | | ***6 - 10 Years*** | 0.575 | .310 | .350 | -.29 | 1.44 |
| | | ***11 - 19 Years*** | 0.643 | .279 | .152 | -.13 | 1.42 |

Source: SPSS output

*Based on culture*

Table 4.51 in the appendix section shows the ANOVA analysis for the cost decision-making factors in mega projects based on culture. For all item constructs with exception of DM6, the p-value indicated that no statistical difference between the views of the respondents. Table 4.52 below shows the item that portrayed significant difference in views between the respondents.

Table 4.52: Rejected hypothesis

| | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| DM6 | Between Groups | 10.348 | 4 | 2.587 | 5.106 | .001 |
| | Within Groups | 48.642 | 96 | .507 | | |
| | Total | 58.990 | 100 | | | |

Source: SPSS output

The Post hoc test for item DM6 could not be performed because one group had less than two cases. Using the ANOVA results for the three different scenarios, that is, knowledge, experience, and culture, the number of accepted hypothesis far outweigh those that were rejected and consequently, hypothesis 1 was accepted implying there is no significant difference between the perceptions of cost decision-making in mega projects based on knowledge, experience and culture.

*6.5.3 Project risk decision-making in mega projects*

All the initial 20 item constructs represented by R1 to R20 were used in this analysis. The analysis for the differences in perceptions among the respondents for these factors are described in the following three sections after which hypothesis 2 as shown in Table 4.45 was examined for either acceptance or rejection.

*Based on job holder*

The ANOVA analysis was conducted for the 20 item constructs and the results are displayed in Table 4.53 in the appendix section. 15 out of the 20 item constructs showed a p-value of greater than 0.05 indicating there is no statistical difference on the perceptions of the respondents based on knowledge while 5 item constructs reflected statistical difference. Table 4.54 below shows the item constructs where significant differences among the respondents were observed.

Table 4.54: Rejected hypothesis

| | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| R2 | Between Groups | 4.295 | 4 | 1.074 | 2.636 | .039 |
| | Within Groups | 38.695 | 95 | .407 | | |
| | Total | 42.990 | 99 | | | |
| R9 | Between Groups | 8.417 | 4 | 2.104 | 3.138 | .018 |
| | Within Groups | 64.375 | 96 | .671 | | |
| | Total | 72.792 | 100 | | | |
| R17 | Between Groups | 9.346 | 4 | 2.336 | 3.859 | .006 |
| | Within Groups | 58.120 | 96 | .605 | | |
| | Total | 67.465 | 100 | | | |
| R18 | Between Groups | 9.969 | 4 | 2.492 | 3.052 | .020 |
| | Within Groups | 78.388 | 96 | .817 | | |
| | Total | 88.356 | 100 | | | |
| R19 | Between Groups | 7.777 | 4 | 1.944 | 2.496 | .048 |
| | Within Groups | 74.777 | 96 | .779 | | |
| | Total | 82.554 | 100 | | | |

Source: SPSS output

To understand the exact differences in perceptions on the five item constructs namely R2, R9, R17, R18, and R19, a post hoc analysis using Tukey test was conducted for these items. For R2, the results are as shown in Table 4.55 below. From the table, the differences in opinion among the different job groups was seen between others and engineers only while the rest of the respondents had no difference in the perception of considering visibility and downstream consequences during project risk decision-making (R2).

Table 4.55: Tukey HSD test for item construct R2

| Multiple Comparisons | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Tukey HSD** | | | | | | | |
| **Dependent Variable** | | | **Mean Difference (I-J)** | **Std. Error** | **Sig.** | **95% Confidence Interval** | |
| | | | | | | **Lower Bound** | **Upper Bound** |
| **R2** | **Engineer** | **Project Manager** | .483 | .233 | .240 | -0.16 | 1.13 |
| | | **Director** | .550 | .202 | .058 | -0.01 | 1.11 |
| | | **CEO** | 0.6 | .319 | .335 | -0.29 | 1.49 |
| | | **Other** | .493* | .173 | .041 | 0.01 | .97 |
| | **Other** | **Engineer** | -.493* | .173 | .041 | -.97 | -0.01 |
| | | **Project Manager** | -.010 | .208 | 1.000 | -.59 | 0.57 |
| | | **Director** | 0.057 | .173 | .997 | -.42 | 0.54 |
| | | **CEO** | 0.107 | .302 | .997 | -.73 | 0.95 |

Source: SPSS output

For item construct R9, the results of the Tukey test as shown in Table 4.56 below. Similar to R2, the differences in opinion in item construct R9 is also only between engineers and others whereas the perception between the rest of the respondents was not different.

Table 4.56: Tukey HSD test for item construct R9

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| ***Multiple Comparisons*** | | | | | | | |
| ***Tukey HSD*** | | | | | | | |
| ***Dependent Variable*** | | | ***Mean Difference (I-J)*** | ***Std. Error*** | ***Sig.*** | ***95% Confidence Interval*** | |
| | | | | | | ***Lower Bound*** | ***Upper Bound*** |
| ***R9*** | ***Engineer*** | ***Project Manager*** | .750 | .296 | .092 | -0.07 | 1.57 |
| | | ***Director*** | .683 | .256 | .066 | -0.03 | 1.39 |
| | | ***CEO*** | 0.133333 | .407 | .997 | -1.00 | 1.27 |
| | | ***Other*** | .659* | .218 | .026 | 0.05 | 1.27 |
| | ***Other*** | ***Engineer*** | -.659* | .218 | .026 | -1.27 | -0.05 |
| | | ***Project Manager*** | .091 | .267 | .997 | -.65 | 0.83 |
| | | ***Director*** | 0.024 | .222 | 1.000 | -.59 | 0.64 |
| | | ***CEO*** | -0.526 | .387 | .656 | -1.60 | 0.55 |

Source: SPSS output

For item construct R17, the Tukey test results are shown in Table 4.57 below. Here, differences in perceptions were seen between CEO and director and also between CEO and others. The rest showed no statistical difference in the way they viewed problems ambiguity in project risk decisions (R17).

Table 4.57: Tukey HSD test for item construct R17

| Multiple Comparisons | | | | | | | |
|---|---|---|---|---|---|---|---|
| ***Tukey HSD*** | | | | | | | |
| ***Dependent Variable*** | | | ***Mean Difference (I-J)*** | ***Std. Error*** | ***Sig.*** | ***95% Confidence Interval*** | |
| | | | | | | ***Lower Bound*** | ***Upper Bound*** |
| ***R17*** | ***Director*** | ***Engineer*** | -.479 | .243 | .289 | -1.15 | .20 |
| | | ***Project Manager*** | -.300 | .284 | .828 | -1.09 | .49 |
| | | ***CEO*** | -1.250* | .389 | .015 | -2.33 | -.17 |
| | | ***Other*** | -.027 | .211 | 1.000 | -0.61 | .56 |
| | ***CEO*** | ***Engineer*** | 0.771429 | .387 | .278 | -.31 | 1.85 |
| | | ***Project Manager*** | .950 | .414 | .156 | -.20 | 2.10 |
| | | ***Director*** | 1.250* | .389 | .015 | .17 | 2.33 |
| | | ***Other*** | 1.223* | .368 | .011 | .20 | 2.25 |
| | ***Other*** | ***Engineer*** | -0.45183 | .207 | .196 | -1.03 | 0.12 |
| | | ***Project Manager*** | -.273 | .254 | .819 | -.98 | 0.43 |
| | | ***Director*** | 0.027 | .211 | 1.000 | -.56 | 0.61 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | ***CEO*** | -1.223* | .368 | .011 | -2.25 | -0.20 |

Source:SPSS output

Table 4.58 below show the Tukey test for item construct R18. For this item construct, the differences in perception were found only between CEO and others, the rest of the respondents had no statistical difference in their perception with respect to the consideration of external dependencies during project risk decisions.

Table 4.58: Tukey HSD test for item construct R18

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | ***Multiple Comparisons*** | | | | | |
| ***Tukey HSD*** | | | | | | | |
| ***Dependent Variable*** | | | ***Mean Difference (I-J)*** | ***Std. Error*** | ***Sig.*** | ***95% Confidence Interval*** | |
| | | | | | | ***Lower Bound*** | ***Upper Bound*** |
| ***R18*** | ***CEO*** | ***Engineer*** | .638 | .450 | .617 | -0.61 | 1.89 |
| | | ***Project Manager*** | 1.067 | .481 | .182 | -0.27 | 2.40 |
| | | ***Director*** | 1.1 | .452 | .115 | -0.16 | 2.36 |
| | | ***Other*** | 1.214* | .427 | .042 | 0.03 | 2.40 |
| | ***Other*** | ***Engineer*** | -0.57586 | .241 | .126 | -1.24 | 0.09 |
| | | ***Project Manager*** | -.147 | .295 | .987 | -.97 | 0.67 |
| | | ***Director*** | -0.114 | .245 | .990 | -.79 | 0.57 |
| | | ***CEO*** | -1.214* | .427 | .042 | -2.40 | -0.03 |

Source: SPSS output

Table 4.59 below shows the Turkey test for R19 where at 0.05 significance, no statistical difference is observed among the respondents, which could be attributed to the p-value for R19 at 0.048, approximated as 0.05. At 0.10 significance, the perception between CEO and others was statistically different in terms of considering the largeness and uncertainty of scope during project risk decisions (R19).

Table 4.60: Tukey HSD test for item construct R19

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | ***Multiple Comparisons*** | | | | | |
| ***Tukey HSD*** | | | | | | | |
| ***Dependent Variable*** | | | ***Mean Difference (I-J)*** | ***Std. Error*** | ***Sig.*** | ***95% Confidence Interval*** | |
| | | | | | | ***Lower Bound*** | ***Upper Bound*** |
| ***R19*** | ***CEO*** | ***Engineer*** | .533 | .439 | .743 | -0.69 | 1.75 |
| | | ***Project Manager*** | .950 | .470 | .263 | -0.36 | 2.26 |
| | | ***Director*** | 1 | .441 | .165 | -0.23 | 2.23 |
| | | ***Other*** | 1.037 | .417 | .102 | -0.12 | 2.20 |
| | ***Other*** | ***Engineer*** | -0.50388 | .235 | .210 | -1.16 | 0.15 |
| | | ***Project Manager*** | -.087 | .288 | .998 | -.89 | 0.71 |
| | | ***Director*** | -0.037 | .239 | 1.000 | -.70 | 0.63 |
| | | ***CEO*** | -1.037 | .417 | .102 | -2.20 | 0.12 |

Source: SPSS output

*Based on experience*

Table 4.61 in the appendix section shows the ANOVA analysis for the 20 item constructs that checked project risk decision-making. All the 20 item constructs had a p-value greater than 0.05 and thus implied that there was no statistical difference in the perception of respondents with regards to project risk decision-making factors based on experience.

*Based on culture*

Table 4.62 in the appendix section shows the ANOVA analysis for the 20 item constructs that checked project risk decision-making based on culture. Among the 20 item constructs, 19 item constructs had a p-value greater than 0.05and thus implied that there was no statistical difference in the perception of respondents with regards to these project risk decision-making factors. One item construct R20, had a value of 0.048 approximated as 0.05, hence also can be considered as no statistical difference among respondents on this factor. The study thus shows that there is no statistical difference between the respondents' perceptions on ‘project risk factors in mega projects based on culture’.

*6.5.4 Personality traits on cost decisions*

The 12 factors that were considered for Personality traits on cost decision-making were reduced to nine as three factors namely hindsight, scale, and representativeness showed ‘unacceptable’ item constructs as per the survey feedback from respondents and hence were not considered in these subsequent analysis. The remaining nine factors were each examined based on knowledge, experience, and culture.

*Based on Job holder*

*Controllability*

Controllability was analysed using 4 item constructs and the results of the ANOVA analysis is as shown in Table 4.63in the appendix. From the table, all item constructs showed no statistical difference in the perceptions of respondents on the controllability elements of cost decision-making.

*Availability*

The factor was measured using 5 item constructs and the ANOVA analysis is shown in Table 4.64in the appendix section. Four item constructs among the five showed no statistical difference among the respondents on the availability elements that influence cost decision-making based on knowledge while one item construct denoted by A2 showed statistical difference. Table 4.65 shows the Tukey test to identify which groups have differences in perception of the item constructs under study. From this table, differences in perception were observed between engineers and project managers, engineers and directors, and engineers and others, the rest of the groups showed no statistical difference in opinion regarding using past cost mistakes to make important decisions (A2).

Table 4.65: Tukey test for item construct A2 based on Jobholder.

| Multiple Comparisons | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Tukey HSD** | | | | | | | |
| **Dependent Variable** | | | **Mean Difference (I-J)** | **Std. Error** | **Sig.** | **95% Confidence Interval** | |
| | | | | | | **Lower Bound** | **Upper Bound** |
| **A2** | **Engineer** | **Project Manager** | -1.369* | .310 | .000 | -2.23 | -0.51 |
| | | **Director** | -1.119* | .268 | .001 | -1.86 | -0.37 |
| | | **CEO** | -1.019 | .427 | .127 | -2.21 | 0.17 |
| | | **Other** | -.759* | .228 | .011 | -1.39 | -.12 |
| | **Project Manager** | **Engineer** | 1.369* | .310 | .000 | 0.51 | 2.23 |
| | | **Director** | .250 | .313 | .930 | -.62 | 1.12 |
| | | **CEO** | .350 | .456 | .939 | -.92 | 1.62 |
| | | **Other** | .610 | .280 | .196 | -.17 | 1.39 |
| | **Director** | **Engineer** | 1.119* | .268 | .001 | 0.37 | 1.86 |
| | | **Project Manager** | -.250 | .313 | .930 | -1.12 | .62 |
| | | **CEO** | .100 | .429 | .999 | -1.09 | 1.29 |
| | | **Other** | .360 | .232 | .531 | -.28 | 1.01 |
| | **CEO** | **Engineer** | 1.019 | .427 | .127 | -0.17 | 2.21 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | **Project Manager** | -.350 | .456 | .939 | -1.62 | .92 |
| | | **Director** | -.100 | .429 | .999 | -1.29 | 1.09 |
| | | **Other** | .260 | .405 | .968 | -.87 | 1.39 |
| | **Other** | **Engineer** | .759* | .228 | .011 | 0.12 | 1.39 |
| | | **Project Manager** | -.610 | .280 | .196 | -1.39 | .17 |
| | | **Director** | -.360 | .232 | .531 | -1.01 | 0.28 |
| | | **CEO** | -.260 | .405 | .968 | -1.39 | .87 |

Source: SPSS output

*Anchoring*

All five item constructs were analysed using ANOVA analysis and the results are as shown in Table 4.66in the appendix section. Item constructs denoted by An1 and An5 showed statistical difference among the group's perception and were further analysed using Tukey test. For item construct An1, the results of the Tukey test are shown in Table 4.67 below. From Table 4.67, the statistical difference in perception of anchoring elements on cost decision-making was observed only between engineer and others implying their view towards having influence over cost risk factors differed (An1).

Table 4.67: Tukey test for item construct An1 based on knowledge

| |
|---|
| ***Multiple Comparisons*** |
| ***Tukey HSD*** |

| Dependent Variable | | | Mean Difference (I-J) | Std. Error | Sig. | 95% Confidence Interval | |
|---|---|---|---|---|---|---|---|
| | | | | | | Lower Bound | Upper Bound |
| An1 | Engineer | Project Manager | -.655 | .254 | .083 | -1.36 | .05 |
| | | Director | -.521 | .219 | .130 | -1.13 | .09 |
| | | CEO | -0.37143 | .349 | .825 | -1.34 | .60 |
| | | Other | -.548* | .188 | .035 | -1.07 | -.03 |
| | Other | Engineer | .548* | .188 | .035 | .03 | 1.07 |
| | | Project Manager | -.107 | .230 | .990 | -.75 | 0.53 |
| | | Director | 0.026 | .191 | 1.000 | -.50 | 0.56 |
| | | CEO | 0.176 | .332 | .984 | -.75 | 1.10 |

Source: SPSS output

For item construct An5, the Tukey test is shown in Table 4.68 below where, similarly to item construct An1, the differences in perception of the anchoring elements influencing cost decision based on knowledge was between engineers and others while the rest of the groups has no statistical difference.

Table 4.68:Tukey test for item construct An5 based on knowledge

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | ***Multiple Comparisons*** | | | | | |
| ***Tukey HSD*** | | | | | | | |
| ***Dependent Variable*** | | | ***Mean Difference (I-J)*** | ***Std. Error*** | ***Sig.*** | ***95% Confidence Interval*** | |
| | | | | | | ***Lower Bound*** | ***Upper Bound*** |
| ***An5*** | ***Engineer*** | ***Project Manager*** | -.560 | .269 | .238 | -1.31 | .19 |
| | | ***Director*** | -.610 | .233 | .075 | -1.26 | .04 |
| | | ***CEO*** | -0.00952 | .370 | 1.000 | -1.04 | 1.02 |
| | | ***Other*** | -.667* | .199 | .010 | -1.22 | -.11 |
| | ***Other*** | ***Engineer*** | .667* | .199 | .010 | .11 | 1.22 |
| | | ***Project Manager*** | .107 | .244 | .992 | -.57 | 0.78 |
| | | ***Director*** | 0.057 | .202 | .999 | -.51 | 0.62 |
| | | ***CEO*** | 0.657 | .352 | .343 | -.32 | 1.64 |

Source: SPSS output

*Conformation*

Conformation was analysed using four elements instead of the five elements since item construct CN5 was deleted to increase reliability of the item constructs. The ANOVA analysis for the remaining item constructs is as shown in Table 4.69 in the appendix section. From the table, item construct CN1 and CN2 show statistical difference among the respondents hence these elements were further analysed using Tukey test. The results of the Tukey test for item construct CN1 and CN2 are shown in Table 4.70 below. From the table, statistical difference in CN1 is observed only between engineers and others whereas for CN2, the statistical difference is between project manager and engineer.

Table 4.70: Tukey test for item construct CN1 and CN2

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | ***Multiple Comparisons*** | | | | | |
| ***Tukey HSD*** | | | | | | | |
| ***Dependent Variable*** | | | ***Mean Difference (I-J)*** | ***Std. Error*** | ***Sig.*** | ***95% Confidence Interval*** | |
| | | | | | | ***Lower Bound*** | ***Upper Bound*** |
| ***CN1*** | ***Engineer*** | ***Project Manager*** | -.405 | .289 | .627 | -1.21 | .40 |
| | | ***Director*** | -.171 | .249 | .959 | -0.86 | .52 |
| | | ***CEO*** | -0.57143 | .397 | .603 | -1.67 | .53 |
| | | ***Other*** | -.643* | .213 | .027 | -1.24 | -.05 |
| | ***Other*** | ***Engineer*** | .643* | .213 | .027 | .05 | 1.24 |
| | | ***Project Manager*** | .238 | .261 | .892 | -.49 | 0.96 |
| | | ***Director*** | 0.471 | .217 | .198 | -.13 | 1.07 |
| | | ***CEO*** | 0.071 | .377 | 1.000 | -.98 | 1.12 |
| ***CN2*** | ***Engineer*** | ***Project Manager*** | -.631* | .226 | .048 | -1.26 | 0.00 |
| | | ***Director*** | -.081 | .195 | .994 | -.62 | 0.46 |
| | | ***CEO*** | -0.381 | .311 | .736 | -1.24 | 0.48 |
| | | ***Other*** | -0.381 | .166 | .156 | -.84 | 0.08 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | ***Project Manager*** | ***Engineer*** | .631* | .226 | .048 | .00 | 1.26 |
| | | ***Director*** | .550 | .228 | .121 | -.08 | 1.18 |
| | | ***CEO*** | 0.250 | .332 | .943 | -.67 | 1.17 |
| | | ***Other*** | 0.250 | .204 | .736 | -.32 | 0.82 |

Source: SPSS output

*Cognitive dissonance*

All 4 item constructs were analysed for this personality trait factor and the results of the ANOVA analysis is as shown in Table 4.71in the appendix section where all the item constructs show there is no statistical difference in the perception of respondents based on knowledge.

*Dread*

The dread factor was analysed using 3 item constructs as one item construct was deleted to improve the reliability of these constructs. The ANOVA analysis of the remaining 3 item constructs is as shown in Table 4.72in the appendix section. The results of the ANOVA analysis indicate there is no statistical difference in the perceptions of respondents by checking the dread elements of cost decision-making based on knowledge

*Familiarity*

Familiarity was analysed using 2 item constructs, F1 and F3, and the ANOVA analysis for the item constructs is as shown in Table 4.73in the appendix section. The results of the ANOVA analysis show that there is no statistical difference in the perception of respondents checking the familiarity elements on cost decision-making based on knowledge.

*Optimism*

Optimism was examined using 2 item constructs and the ANOVA analysis is as shown in Table 4.74in the appendix section. From table 4.74, both item constructs indicate no statistical difference in perception of optimism elements on cost decision-making based on knowledge. Note, the p-value for item construct O2 is approximated as 0.05.

*Venturesomeness*

Venturesomeness was analysed using 2 item constructs and the results of the ANOVA is as shown in Table 4.75in the appendix section. Both item constructs show no statistical difference in the perception of respondents on venturesomeness elements on cost decision-making based on knowledge.

*Based on experience*

*Controllability*

The ANOVA analysis for controllability elements on cost decision-making based on experience is as shown in Table 4.76in the appendix section. All elements show no statistical difference in perception of the controllability elements.

*Availability*

As shown in Table 4.77 in the appendix section, item constructs A2, A3, A4, and A5 showed no statistical difference among the respondents on the availability elements on cost decision-making based on experience while item construct A1 showed statistical difference. The Tukey test for A1 is shown in Table 4.78 below. There is marginal difference between the respondents with 6 – 10 years and those between 11 – 19 years on how the manage cost decisions concerning experiences. The other respondents had no statistical difference in perception of this element.

Table 4.78: Tukey test for item construct A1

| Multiple Comparisons | | | | | | | |
|---|---|---|---|---|---|---|---|
| ***Tukey HSD*** | | | | | | | |
| ***Dependent Variable*** | | | ***Mean Difference (I-J)*** | ***Std. Error*** | ***Sig.*** | ***95% Confidence Interval*** | |
| | | | | | | ***Lower Bound*** | ***Upper Bound*** |
| ***A1*** | ***6 - 10 Years*** | ***0 - 2 Years*** | -.421 | .286 | .582 | -1.22 | .37 |
| | | ***3 - 5 Years*** | -.365 | .310 | .765 | -1.23 | 0.50 |
| | | ***11 - 19 Years*** | -.693 | .251 | .052 | -1.39 | .00 |
| | | ***20 Years or Above*** | -.008 | .310 | 1.000 | -.87 | 0.86 |
| | ***11 - 19 Years*** | ***0 - 2 Years*** | .272 | .251 | .814 | -.43 | .97 |
| | | ***3 - 5 Years*** | .329 | .279 | .763 | -.45 | 1.10 |
| | | ***6 - 10 Years*** | .693 | .251 | .052 | .00 | 1.39 |
| | | ***20 Years or Above*** | .686 | .279 | .108 | -.09 | 1.46 |

Source: SPSS output

*Anchoring*

The five item constructs namely An1 to An5 were checked for statistical difference in perception based on experience and the results of the ANOVA analysis is as shown in Table 4.79 in the appendix section. All five item constructs showed no statistical difference in the perception of anchoring elements of cost decision-making based on experience.

*Conformation*

The four item constructs namely C1 to C4 generated similar results as anchoring elements where for all items analysed, the ANOVA analysis showed no statistical difference in the perceptions of respondents on the conformation elements related to cost decision-making based on the experience as shown in Table 4.80 in the appendix section.

*Cognitive Dissonance*

The four item constructs analysed for cognitive dissonance factor displayed that two item constructs namely CD2 and CD3 showed statistical difference in perception of respondents on cognitive dissonance element of cost decision-making based on experience as shown in Table 4.81 in the appendix section. CD2 and CD3 was further analysed using Tukey test and the result is as shown in Tables 4.82 and 4.83 below respectively. From the tables it is noted that the differences in perception among the groups is only between those with 0 – 2 years and 11 – 19 years for both item constructs. However, out of four item constructs, two of them showed statistical difference, the percentage of this difference is minimal and thus no statistical difference is concluded in the perception of respondents on cognitive dissonance elements related to cost decision-making based on experience.

Table 4.82: Tukey test for item construct CD2

| | |
|---|---|
| | ***Multiple Comparisons*** |
| ***Tukey HSD*** | |

| ***Dependent Variable*** | | | ***Mean Difference (I-J)*** | ***Std. Error*** | ***Sig.*** | ***95% Confidence Interval*** | |
|---|---|---|---|---|---|---|---|
| | | | | | | ***Lower Bound*** | ***Upper Bound*** |
| ***CD2*** | ***0 - 2 Years*** | ***3 - 5 Years*** | .654 | .319 | .250 | -.23 | 1.54 |
| | | ***6 - 10 Years*** | .421 | .294 | .608 | -.40 | 1.24 |
| | | ***11 - 19 Years*** | 1.054* | .258 | .001 | .34 | 1.77 |
| | | ***20 Years or Above*** | .440 | .319 | .642 | -.45 | 1.33 |
| | ***11 - 19 Years*** | ***0 - 2 Years*** | -1.054* | .258 | .001 | -1.77 | -.34 |
| | | ***3 - 5 Years*** | -.400 | .286 | .631 | -1.20 | 0.40 |
| | | ***6 - 10 Years*** | -.633 | .258 | .110 | -1.35 | .08 |
| | | ***20 Years or Above*** | -.614 | .286 | .210 | -1.41 | 0.18 |

Source: SPSS output

Table 4.83: Tukey test for item construct CD3

| Multiple Comparisons | | | | | | | |
|---|---|---|---|---|---|---|---|
| ***Tukey HSD*** | | | | | | | |
| ***Dependent Variable*** | | | ***Mean Difference (I-J)*** | ***Std. Error*** | ***Sig.*** | ***95% Confidence Interval*** | |
| | | | | | | ***Lower Bound*** | ***Upper Bound*** |
| ***CD3*** | ***0 - 2 Years*** | ***3 - 5 Years*** | .320 | .340 | .880 | -.62 | 1.26 |
| | | ***6 - 10 Years*** | .105 | .313 | .997 | -.76 | 0.97 |
| | | ***11 - 19 Years*** | .752 | .276 | .058 | -.02 | 1.52 |
| | | ***20 Years or Above*** | -.109 | .340 | .998 | -1.05 | 0.84 |
| | ***11 - 19 Years*** | ***0 - 2 Years*** | -.752 | .276 | .058 | -1.52 | .02 |
| | | ***3 - 5 Years*** | -.433 | .306 | .620 | -1.28 | 0.42 |
| | | ***6 - 10 Years*** | -.647 | .276 | .140 | -1.41 | .12 |
| | | ***20 Years or Above*** | -.861* | .306 | .046 | -1.71 | -0.01 |

Source: SPSS output

*Dread*

From the ANOVA analysis of the 3 item constructs as shown in Table 4.84 in the appendix section, all item constructs showed no statistical difference in the perception of the dread elements on cost decision-making based on experience.

*Familiarity*

Similar to the dread elements, the familiarity elements under this analysis showed no statistical significance in the perception of respondents on cost decision-making based on experience as shown in Table 4.85 in the appendix section.

*Optimism*

The 2 item constructs that checked optimism on cost decision-making showed no statistical difference in perception of respondents based on experience as shown in Table 4.86 in the appendix section.

*Venturesomeness*

Based on experience, the 2 item constructs, V1 and V3 were analysed using ANOVA and result shown in Table 4.87 in the appendix section. From the table, item construct V3 showed statistical difference while V1 showed no statistical difference in the perception of respondents on venturesomeness elements of cost decision-making. V3 was further analysed using Tukey test to identify exactly in which group the difference appears. The results are shown in Table 4.88 below. For item construct V3, the differences in perception was observed between respondents with 3 – 5 years' experience and two groups which are those with 6 – 10 years and 11 – 19 years. The perception between the other groups on this element was not statistically different.

Table 4.88: Tukey test for item construct V3

| ***Multiple Comparisons*** | | | | |
|---|---|---|---|---|
| ***Tukey HSD*** | | | | |
| ***Dependent Variable*** | | ***Std. Error*** | ***Sig.*** | ***95% Confidence Interval*** |

| | | | Mean Difference (I-J) | | | Lower Bound | Upper Bound |
|---|---|---|---|---|---|---|---|
| V3 | 3 - 5 Years | 0 - 2 Years | -0.485 | 0.219 | 0.183 | -1.094 | 0.124 |
| | | 6 - 10 Years | -.748* | 0.219 | 0.008 | -1.357 | -0.140 |
| | | 11 - 19 Years | -.757* | 0.197 | 0.002 | -1.304 | -0.211 |
| | | 20 Years or Above | -0.643 | 0.235 | 0.056 | -1.296 | 0.010 |
| | 6 - 10 Years | 0 - 2 Years | 0.263 | 0.202 | 0.689 | -0.297 | 0.824 |
| | | 3 - 5 Years | .748* | 0.219 | 0.008 | 0.140 | 1.357 |
| | | 11 - 19 Years | -0.009 | 0.177 | 1.000 | -0.501 | 0.483 |
| | | 20 Years or Above | 0.105 | 0.219 | 0.989 | -0.503 | 0.714 |
| | 11 - 19 Years | 0 - 2 Years | 0.272 | 0.177 | 0.541 | -0.220 | 0.765 |
| | | 3 - 5 Years | .757* | 0.197 | 0.002 | 0.211 | 1.304 |
| | | 6 - 10 Years | 0.009 | 0.177 | 1.000 | -0.483 | 0.501 |
| | | 20 Years or Above | 0.114 | 0.197 | 0.977 | -0.432 | 0.661 |

Source: SPSS output

*Based on culture*

For all item constructs checked under personality traits influencing cost decision-making in mega projects that included controllability, availability, anchoring, conformation, cognitive dissonance, dread, familiarity, optimism, and venturesomeness, the items showed no statistical difference among the respondents as shown in Table 4.89 to Table 4.97 in the appendix section.

*6.5.5 Factors contributing to project cost overrun*

Five item constructs denoted by OV1 to OV5 were applied in the study to gauge the perception of respondents on the factors they considered contribute to project cost overrun. The ANOVA analysis was conducted based on knowledge, experience and culture and the results is as follows.

*Based on Jobholder*

Four item constructs out of five showed no statistical difference in the perception of respondents on the factors contributing to project cost overrun and thus it was concluded no statistical difference exists among respondents. To have an in-depth view of the statistical difference shown by item construct OV2 as per Table 4.98 in the appendix section, the Tukey test was performed and results shown in Table 4.99 below. The difference in perception on the OV2 item construct was found to be between engineers and CEO only while the rest no statistical difference was noted.

Table 4.99: Tukey test for item construct OV2

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| ***Multiple Comparisons*** | | | | | | | |
| ***Tukey HSD*** | | | | | | | |
| ***Dependent Variable*** | | | ***Mean Difference (I-J)*** | ***Std. Error*** | ***Sig.*** | ***95% Confidence Interval*** | |
| | | | | | | ***Lower Bound*** | ***Upper Bound*** |
| ***OV2*** | ***Engineer*** | ***Project Manager*** | -.869 | .422 | .247 | -2.04 | .30 |
| | | ***Director*** | -.719 | .364 | .287 | -1.73 | .29 |
| | | ***CEO*** | -1.819* | .580 | .019 | -3.43 | -.21 |
| | | ***Other*** | -.549 | .311 | .398 | -1.41 | .31 |
| | ***CEO*** | ***Engineer*** | 1.819* | .580 | .019 | .21 | 3.43 |
| | | ***Project Manager*** | .950 | .621 | .546 | -.78 | 2.68 |
| | | ***Director*** | 1.100 | .583 | .332 | -.52 | 2.72 |
| | | ***Other*** | 1.270 | .551 | .153 | -.26 | 2.80 |

Source: SPSS output

*Based on experience*

All the five item constructs that checked project cost overrun factors showed no statistical difference in the perception of respondents based on experience as shown in Table 4.100 in the appendix section.

*Based on culture*

Four out of five item constructs showed no statistical difference in the perception of respondents on the project cost overrun factors as shown in Table 4.101 in the appendix section. Item construct OV5 showed statistical difference but the Tukey test could not be performed since one group had less than two cases. Since the number of item constructs showing no statistical difference is higher than the one showing statistical difference, then it can be concluded that no statistical difference exist.

*6.5.6 Summary*

At first, Harman's Single-Factor test was used to test Common Method Variance and found it is not present. Secondly, reliability checks were undertaken in all the factors where risk and decision-making was found to have the perfect reliability, followed by cognitive biases, then project cost overrun constructs and lastly, decision-making constructs. Here, several constructs were deleted to improve the reliability. Item DM4 deleted to improve reliability of decision-making constructs. For personality traits on project cost decisions, CN5 was deleted to improve reliability of conformation, D4 was deleted to improve reliability of dread constructs, F2 was deleted to improve reliability of familiarity constructs, all item constructs under hindsight, scale, and representativeness were deleted, O3 was deleted under optimism, and lastly, V2 under venturesomeness was also deleted.

Thirdly, the descriptive statistics for all item constructs was examined. The results showed that decision-making influences mega projects and risk was found to influence decision-making in mega projects. For the cognitive biases constructs, controllability, availability, anchoring, conformation, familiarity, hindsight, scale, optimism, and venturesomeness were found to be important elements of decision-making in mega projects whereas cognitive dissonance, dread, and representativeness were found not to have much influence on decision-making. The project's cost overrun factors showed mixed results where overoptimistic forecasts of project budget, egocentric interpretation of project scope, and cognitive delusion about project scope were found to show lesser risk of project cost overrun at 15% while misplaced incentives about project return and desirability of a positive project outcome showed a higher risk at over 20%.

On a few item constructs, statistical difference was observed and the overall variance analysis showed that there is no statistical difference between the perceptions of respondents on decision-making factors in mega projects. On projects, risk factors influencing decision-making in mega projects, on cognitive biases represented by personality traits relating to decision-making, and on the project cost overrun factors implying all hypothesis in this section were accepted since the majority of respondents showed no statistical difference.

*6.6 Association Analysis*

*6.6.1 Normality tests*

Normality test guides the selection of the data analysis model and in regression analysis, normality check is essential. Skewness and kurtosis provide an indication of the distribution shape of variables under study where skewness checks the symmetry and kurtosis looks at the peakedness of the distribution. Different significance levels have different critical values, for instance for 0.05 significance, the critical range is +/- 1.96 and for 0.01 significance it is +/- 2.58 (Ghasemi & Zahedias, 2012).The skewness values for this research show the distribution shape is normal. Most kurtosis values show distribution shape is normal except for anchoring, conformation, and familiarity as the values are outside +/- 2.58. Since minimal deviation from normality does not affect the results of a parametric test in cases of large samples (Ghasemi & Zahedias, 2012). The distribution shape for this study variables is considered normal since 21/24(87.5%) of values show normality.

Table 4.102: Summary of Normality checks

| **Variable** | **Skewness** | **Kurtosis** |
|---|---|---|
| **Decision-making** | 0.325 | 1.001 |
| **Risk** | 0.408 | -0.258 |
| **Controllability** | -1.368 | 2.467 |
| **Availability** | -1.179 | 1.658 |
| **Anchoring** | -1.519 | 2.605 |
| **Conformation** | -2.055 | 6.239 |
| **Cognitive Dissonance** | 0.034 | -0.984 |
| **Dread** | 0.014 | -0.812 |
| **Familiarity** | -1.787 | 4.376 |
| **Optimism** | -0.731 | -1.16 |
| **Venturesomeness** | -1.798 | 3.7 |
| **Cost Overrun** | -0.125 | -0.687 |

Source: SPSS output

*6.6.2 Linearity test*

Many statistical tests such as univariate, bivariate and inferential statistics assume the data is linear and thus the linearity test is used to confirm this. For instance, in order to undertake regression model, linearity test need to be conducted. Linearity test looks at confirming the relationship of the dependent variables and independent variables follow the linear equation in which Y variable is related to X variables using a calculated equation. Before conducting the simple linear regression model in this study to check the relationship between over optimism factors and project cost overrun, linearity test was undertaken on each research construct (Field, 2016). The results from the normality P - P plots (Figures 25 – 37 in appendix) were checked for linearity. The P-P plots show that the residual graphs are nearly a straight line over the diagonal fitting axis demonstrating that the randomness of the residuals is observed.

### *6.6.3 Multicollinearity Test – Tolerance and VIF*

Multicollinearity exists when the independent variables are highly correlated with each other. Multicollinearity is tested by first checking the degree of correlations between the research independent variables. Pearson's correlation coefficient was applied in this study and if the degree of correlation is lower than 0.8 then it indicates no multicollinearity as a value of 1 or -1 indicates perfect correlation. Thus, the lower the figure the less the presence of multicollinearity. Table 4.103 in appendix section shows the highest correlation is between cognitive dissonance and dread factors at 0.534 indicating the independent variables in this study have no multicollinearity. Secondly, also tolerance and variance inflation factor (VIF) gauge the existence of multicollinearity. If the value of VIF is equal to 1, it shows no correlation, a value of between 1 and 5 shows moderate correlation while above 5, high correlation (Daoud, 2017). For tolerance values between 0.1 and 1, no multicollinearity is reported. Table 4.104 below indicate tolerance and VIF values are within required range. Hence, reflecting non-existence of multicollinearity in the study data.

Table 4.104: Tolerance and VIF values for independent variables

| Model | | Collinearity Statistics | |
|---|---|---|---|
| | | Tolerance | VIF |
| 1 | Controllability | .785 | 1.273 |
| | Availability | .750 | 1.334 |
| | Anchoring | .529 | 1.889 |
| | Conformation | .708 | 1.412 |
| | Cognitive Dissonance | .560 | 1.785 |
| | Dread | .549 | 1.821 |
| | Familiarity | .566 | 1.765 |
| | Optimism | .753 | 1.328 |
| | Venturesomeness | .638 | 1.567 |

a. Dependent Variable: DM

Source: SPSS output.

*6.6.4 Homoscedasticity verification*

Homoscedasticity is used to check for equal levels of variance between the dependent and the series of independent variables. The assumption is reported if the variance around the regression line is the identical for all values of the independent variable. Similar to Field (2016) and others, this research applied scatterplots to attest the homoscedasticity assumption. Accordingly, Scatter plots of standardised residual were generated for all the research dependent and independent variables, results as shown in Appendix section (Figures 38 – 49). The results showed that there are no visible patterns of residuals. Thus, homoscedasticity assumption is not violated.

*6.6.5 Correlation analysis*

The purpose of this test is to confirm the association between cognitive biases, costs decision-making, risk decisions and project cost overrun. The test will also confirm whether these constructs move in similar or opposite direction.

The results in the above table show that cognitive biases are negatively correlated with cost Decision-making in mega projects. Decision-making is positively correlated to project costs overrun. Most of cognitive biases constructs were negatively correlated to risk decision-making in mega projects with exception of cognitive dissonance and optimism constructs that reflected positively correlation. Risk decision-making is positively correlated to project costs overrun with a lower degree than cost decision-making indicating costs overrun are influenced by making risky decision but all cost decisions whether risky or not, have more impact on costs overrun.

Correlation between research constructs and demographic variables show that only job position and work experience are significantly correlated with conformation and venturesome respectively. Work experience is also negatively correlated with availability, cognitive dissonance, dread, and optimism, project risk environment, and cost decisions, whereas job position is negatively associated with cognitive dissonance, project risk environment, cost decisions, and projects costs overrun.

Table 4.105: Significant relationships between demographics and research constructs.

| | Venturesome | Over_optimism |
|---|---|---|
| Job Position | | .200* |
| Work Experience | .256** | |

Source: Summarised by student base on correlation analysis

*6.6.6 Regression Analysis*

Several linear regression trials were conducted to study the influence of demographic variables on over optimism phenomena in mega projects. None of the demographic variables found to have a significant influence on over optimism. Regression analysis is used to investigate the influence of over optimism on cognitive biases and dependence of decision-making on cognitive biases. This will demonstrate the extent to which decision-making and over optimistic outlook of mega projects depend on manager cognitive biases. The study also will draw conclusion if the project risk environment or context moderate the relationship between the model dependent and independent variables. The relationship checked in this study is trying to validate is shown in the following Figure 50 below.

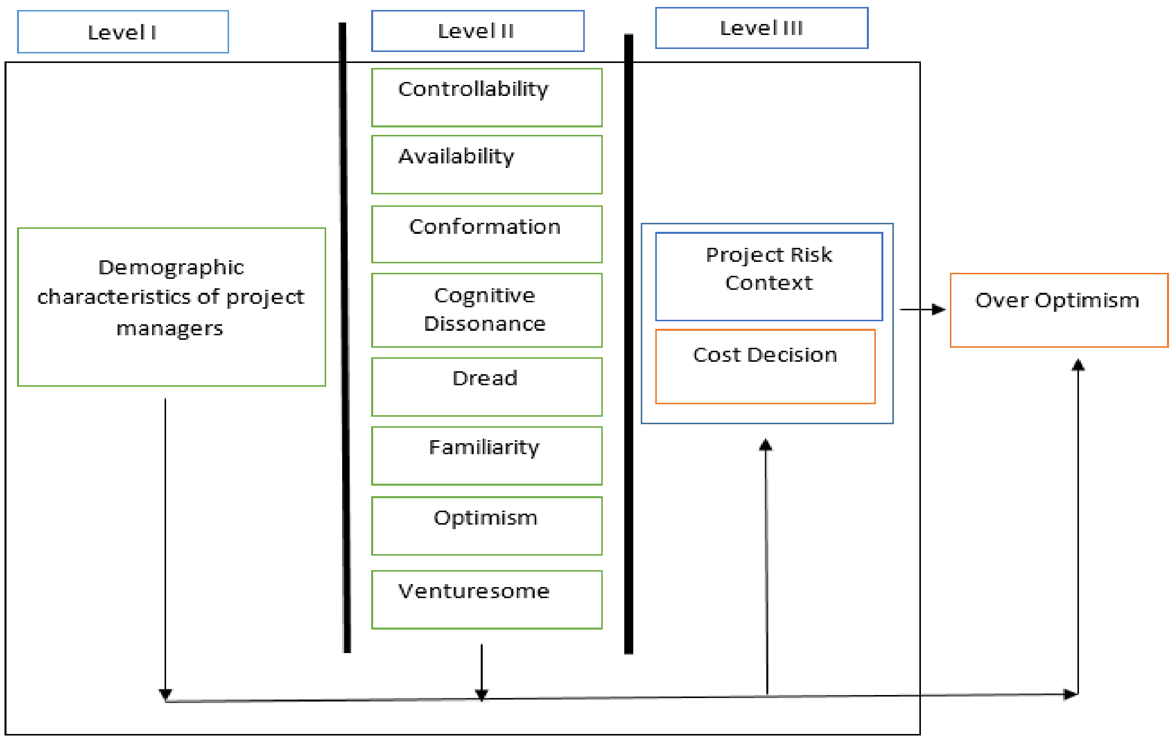


Figure 25: Research Approach

Source: Created by student

*Hypothesis Testing*

Prior to carrying out the hierarchical regression analyses, all the independent variables were subject to several assumption tests were performed on the depend and independent variables. As demonstrated on the previous section. The results showed that all the regression assumptions were observed.

*H1: Controllability cognitive bias is associated with over optimism*

Hypothesis 1 was tested using both correlation and simple regression. The correlation test showed that controllability and over optimism were weakly positively related r (101) = 0.14, and that this association was not significant. Also, simple regression analysis was used to test whether or not controllability predicts over optimism. The test results indicated that the regression is not significant at 0.05 though significant at 0.10, F (1, 99)= 2.803, p = 0.097, $R^2$ = .028.However, controllability contributes positively to over optimism ,that is, greater level of controllability corresponds to higher level of over optimism. However, this hypothesis must be validated by further data collection. Tables below display the regression test outcomes.

Table 4.106: Model summary for controllability and over optimism

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate | Change Statistics | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | R Square Change | F Change | df1 | df2 | Sig. F Change |
| 1 | .166[a] | .028 | .018 | 1.161 | .028 | 2.803 | 1 | 99 | .097 |

a. Predictors: (Constant), Controllability

Source: SPSS output

Table 4.107: ANOVA

| Model | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | 3.781 | 1 | 3.781 | 2.803 | .097[b] |
| | Residual | 133.545 | 99 | 1.349 | | |
| | Total | 137.327 | 100 | | | |

a. Dependent Variable: Cost Overrun

b. Predictors: (Constant), Controllability

Source: SPSS output

Table 4.108: Coefficient summary for controllability and over optimism

| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. |
|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | |
| 1 | (Constant) | 1.924 | .577 | | 3.332 | .001 |
| | Controllability | .259 | .154 | .166 | 1.674 | .097 |

a. Dependent Variable: Cost Overrun

Source: SPSS output

*H2: Availability cognitive bias is associated with over optimism*

Similarly, to hypothesis 2 was verified using both correlation analysis. The correlation test showed that availability and over optimism were weakly positively related r (101) = 0.014, and that this association was not significant. Also, the regression was not significant, F (1, 99)= .036, p = 0.850, $R^2$ = .000. However, Availability influence positively to over optimism, that is, greater level of Availability correspondent to a higher level of over optimism, though, this hypothesis must be authenticated by further data collection. Tables below display the regression test outcomes.

Table 4.109: Model summary for availability and over optimism

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate | Change Statistics | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | R Square Change | F Change | df1 | df2 | Sig. F Change |
| 1 | .019[a] | .000 | -.010 | 1.178 | .000 | .036 | 1 | 99 | .850 |

a. Predictors: (Constant), Availability

Source: SPSS output

Table 4.110: ANOVA

| Model | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | .050 | 1 | .050 | .036 | .850[b] |
| | Residual | 137.277 | 99 | 1.387 | | |
| | Total | 137.327 | 100 | | | |

a. Dependent Variable: Cost Overrun

b. Predictors: (Constant), Availability

Source: SPSS output

Table 4.111: Coefficient summary for availability and over optimism

| Model | | Unstandardized Coefficients | | Standardized Coefficients | T | Sig. |
|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | |
| 1 | (Constant) | 2.758 | .609 | | 4.526 | .000 |
| | Availability | .029 | .153 | .019 | .189 | .850 |

a. Dependent Variable: Cost Overrun

Source: SPSS output

*H3: Anchoring cognitive bias is associated with over optimism*

To test this hypothesis correlation analysis between anchoring and over optimism was conducted. The test showed that there was a weak negative relationship between these variables r(101) = - 0.071 but not significant, p >0.05. Similarly, the regression results were not significant F (1, 99)= .001, p = 0.977, $R^2$ = .000. However, anchoring contributes positively to over optimism, that is, greater level of anchoring corresponds to higher level of over optimism. Though, this hypothesis must be validated by further data collection. Tables below display the regression test outcomes.

Table 4.112: Model summary for anchoring and over optimism

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate | Change Statistics | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | R Square Change | F Change | df1 | df2 | Sig. F Change |
| 1 | .003[a] | .000 | -.010 | 1.178 | .000 | .001 | 1 | 99 | .977 |

a. Predictors: (Constant), Anchoring

Source: SPSS output

Table 113: ANOVA

| Model | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | .001 | 1 | .001 | .001 | .977[b] |
| | Residual | 137.326 | 99 | 1.387 | | |
| | Total | 137.327 | 100 | | | |

a. Dependent Variable: Cost Overrun

b. Predictors: (Constant), Anchoring

Source: SPSS output

Table 4.114: Coefficients for anchoring and over optimism

| Model | Unstandardized Coefficients | | Standardized Coefficients | T | Sig. |
|---|---|---|---|---|---|
| | B | Std. Error | Beta | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| 1 | (Constant) | 2.855 | .573 | | 4.978 | .000 |
| | Anchoring | .004 | .151 | .003 | .029 | .977 |

a. Dependent Variable: Cost Overrun

Source: SPSS output

*H4: Conformation cognitive bias is associated with over optimism*

To test this hypothesis correlation analysis between conformation and over optimism was conducted. The test showed that there was a negative association between these variables but not significant r(101) = - 0.061, $p > 0.05$. Similarly, the regression results were not significant $F(1, 99)= 0.026$, $p = 0.873$, $R^2 = .000$. Tables below display the regression test outcomes.

Table 4.115: Model summary for conformation and over optimism

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate | Change Statistics | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | R Square Change | F Change | df1 | df2 | Sig. F Change |
| 1 | .016[a] | .000 | -.010 | 1.178 | .000 | .026 | 1 | 99 | .873 |

a. Predictors: (Constant), Conformation

Source: SPSS output

Table 4.116: ANOVA

| Model | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | .036 | 1 | .036 | .026 | .873[b] |
| | Residual | 137.291 | 99 | 1.387 | | |
| | Total | 137.327 | 100 | | | |

a. Dependent Variable: Cost Overrun

b. Predictors: (Constant), Conformation

Source: SPSS output

Table 4.117: Coefficients for conformation and over optimism

| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. |
|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | |
| 1 | (Constant) | 2.756 | .728 | | 3.786 | .000 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | Conformation | .030 | .186 | .016 | .161 | .873 |

a. Dependent Variable: Cost Overrun

Source: SPSS output

These results does not support hypothesis 4 in that conformation does not positively influence over optimism, though it shows greater level of conformation correspondents to a higher level of cost overrun in mega projects due to over optimism. This hypothesis must be validated by further data collection.

*H5: Cognitive dissonance cognitive bias is associated with over optimism*

Hypothesis 5 was tested using both correlation and simple regression. The correlation test showed that Dissonance and over optimism were negatively related r (101) = - 0.102, and that this association was not significant at the level $p \leq 0.05$. Regression analysis was also conducted to test whether or not cognitive dissonance predicted over optimism in mega projects. The results are shown in the following tables. This regression was not significant, $F(1,99) = 1.659$, $p = 0.201$, adjusted $R^2 = 0.016$. The results also showed cognitive dissonance does not influence over optimism at level of $p \leq 0.05$. These findings does not support hypothesis 5. Although the results indicate cognitive dissonance is negatively related to over optimism in that, lower levels of dissonance correspondents to a higher level of cost overrun due to over optimism in mega projects. This hypothesis must be validated by further data collection.

Table 4.118: Model summary for cognitive dissonance and over optimism

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate | Change Statistics | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | R Square Change | F Change | df1 | df2 | Sig. F Change |
| 1 | .128[a] | .016 | .007 | 1.168 | .016 | 1.659 | 1 | 99 | .201 |

a. Predictors: (Constant), Cognitive Dissonance

Source: SPSS output

Table 4.119: ANOVA

| Model | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | 2.263 | 1 | 2.263 | 1.659 | .201[b] |
| | Residual | 135.064 | 99 | 1.364 | | |
| | Total | 137.327 | 100 | | | |

a. Dependent Variable: Cost Overrun

b. Predictors: (Constant), Cognitive Dissonance

Source: SPSS output

Table 4.120: Coefficients for cognitive dissonance and over optimism

| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. |
|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | |
| 1 | (Constant) | 3.327 | .373 | | 8.929 | .000 |
| | Cognitive Dissonance | -.155 | .120 | -.128 | -1.288 | .201 |

a. Dependent Variable: Cost Overrun

Source: SPSS output

*H6: Dread cognitive bias is associated with over optimism*

Hypothesis 6was checked using both correlation and simple regression. The correlation test showed that dread and over optimism were negatively related r (101) = -0.174, and that this association was significant at the level p = 0.10. Regression analysis was also conducted to test whether or not dread predicted cost overrun over optimism in mega projects. The results are shown in the following tables. This regression was significant, F(1,99) = 3.957, p = 0.049, R2 = 0.038. The results also showed dread significantly influence cost overrun over optimism at level of $p \leq 0.05$. These findings support hypothesis 6, though the influence is negative in that, greater levels of dread correspondents to a lower level of cost overrun due to over optimism in mega projects.

Table 4.121: Model summary for dread and over optimism

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate | Change Statistics | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | R Square Change | F Change | df1 | df2 | Sig. F Change |
| 1 | .196[a] | .038 | .029 | 1.155 | .038 | 3.957 | 1 | 99 | .049 |

a. Predictors: (Constant), Dread

Source: SPSS output

Table 4.122: ANOVA

| Model | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | 5.277 | 1 | 5.277 | 3.957 | .049[b] |
| | Residual | 132.049 | 99 | 1.334 | | |
| | Total | 137.327 | 100 | | | |

a. Dependent Variable: Cost Overrun

b. Predictors: (Constant), Dread

Source: SPSS output

Table 4.123: Coefficients for dread and over optimism

| Model | | Unstandardized Coefficients | | Standardized Coefficients | T | Sig. |
|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | |
| 1 | (Constant) | 3.626 | .396 | | 9.150 | .000 |
| | Dread | -.256 | .129 | -.196 | -1.989 | .049 |

a. Dependent Variable: Cost Overrun

Source: SPSS output

*H7: Familiarity cognitive bias is associated with over optimism*

To test to this hypothesis, correlation analysis between familiarity and cost overrun due to over optimism was conducted. The test showed that the relationship between these variables was positive but not significant r(101) = .045, $p > 0.05$. Similarly, the regression results were not significant F (1, 99) = .634, p = 0.428, $R^2 = 0.006$. Tables below display the regression test outcomes. These results does not support hypothesis 6 in that familiarity cognitive biases influence cost overrun due to over optimism.

Familiarity was found to be positively related to over optimism that is, greater level of familiarity corresponds to a higher level of cost overrun in mega projects due to over optimism. This hypothesis must be validated by further data collection.

Table 4.124: Model summary for familiarity and over optimism

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate | Change Statistics | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | R Square Change | F Change | df1 | df2 | Sig. F Change |
| 1 | .080[a] | .006 | -.004 | 1.174 | .006 | .634 | 1 | 99 | .428 |

a. Predictors: (Constant), Familiarity

Source: SPSS output

Table 4.125: ANOVA

| Model | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | .873 | 1 | .873 | .634 | .428[b] |
| | Residual | 136.453 | 99 | 1.378 | | |
| | Total | 137.327 | 100 | | | |

a. Dependent Variable: Cost Overrun

b. Predictors: (Constant), Familiarity

Source: SPSS output

Table 4.126: Coefficients for familiarity and over optimism

| Model | | Unstandardized Coefficients | | Standardized Coefficients | T | Sig. |
|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | |
| 1 | (Constant) | 2.326 | .695 | | 3.345 | .001 |
| | Familiarity | .145 | .182 | .080 | .796 | .428 |

a. Dependent Variable: Cost Overrun

Source: SPSS output

*H8: Optimism cognitive bias is associated with over optimism*

Hypothesis 8 was tested for both correlation and regression analysis between optimism and cost overrun due to over optimism. The test showed that the association is negative and there was no significant relationship between these variables r(101) = -.022, $p > 0.05$. Similarly, the regression results were not significant $F(1, 99) = .157$, $p = 0.693$, $R^2 = 0.002$. Tables below display the regression test outcomes. These results does not support hypothesis 8 in that optimism cognitive biases negatively influence cost overrun due to over optimism, that is greater level of optimism correspondents to a low level of cost overrun in mega projects due to over optimism. The negative relationship must be supported by further data collection.

Table 4.127: Model summary for optimism and over optimism

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate | Change Statistics | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | R Square Change | F Change | df1 | df2 | Sig. F Change |
| 1 | .040[a] | .002 | -.009 | 1.177 | .002 | .157 | 1 | 99 | .693 |

a. Predictors: (Constant), Optimism

Source: SPSS output

Table 4.128: ANOVA

| Model | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | .217 | 1 | .217 | .157 | .693[b] |
| | Residual | 137.109 | 99 | 1.385 | | |
| | Total | 137.327 | 100 | | | |

a. Dependent Variable: Cost Overrun

b. Predictors: (Constant), Optimism

Source: SPSS output

Table 4.129: Coefficients for optimism and over optimism

| Model | | Unstandardized Coefficients | | Standardized Coefficients | T | Sig. |
|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | |
| 1 | (Constant) | 3.050 | .466 | | 6.549 | .000 |
| | Optimism | -.053 | .134 | -.040 | -.396 | .693 |

a. Dependent Variable: Cost Overrun

Source: SPSS output

*H9: Venturesomeness cognitive bias is associated with over optimism*

Hypothesis 9 was tested using both correlation and simple regression. The correlation test showed that Venturesome and cost overrun due to over optimism were weakly positively related r (101)= 0.038, and that this association was not significant, $p > 0.05$. Also, simple regression analysis was used to test whether or not Venturesome predicts cost overrun due to over optimism. The test results indicated that the regression is not significant, $F(1, 99) = .043$, $p = 0.836$, $R^2 = 0.000$. Tables below display the regression test outcomes. However, venturesome contributes positively to over optimism that is, greater level of venturesome correspondent to higher level of over optimism. Though, this hypothesis must be validated by further data collection.

Table 4.130: Model summary for venturesomeness and over optimism

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate | Change Statistics | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | R Square Change | F Change | df1 | df2 | Sig. F Change |
| 1 | .021[a] | .000 | -.010 | 1.178 | .000 | .043 | 1 | 99 | .836 |

a. Predictors: (Constant), Venturesomeness

Source: SPSS output

Table 4.131: ANOVA

| Model | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | .060 | 1 | .060 | .043 | .836[b] |
| | Residual | 137.267 | 99 | 1.387 | | |
| | Total | 137.327 | 100 | | | |

a. Dependent Variable: Cost Overrun

b. Predictors: (Constant), Venturesomeness

Source: SPSS output

Table 4.132: Coefficients for venturesomeness and over optimism

| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. |
|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | |
| 1 | (Constant) | 2.712 | .776 | | 3.494 | .001 |
| | Venturesomeness | .042 | .202 | .021 | .208 | .836 |

a. Dependent Variable: Cost Overrun

Source: SPSS output

*H10: Costs decision-making is associated with over optimism*

Hypothesis 10 was tested using both correlation and simple regression. The correlation test showed that costs decision making and cost overrun due to over optimism were positively related, r (101)= 0.166, and that this association was significant at $p \leq 0.10$. Also simple regression analysis was used to test whether or not costs decision-making predicts cost overrun due to over optimism. Similar to the correlation test, the test results indicated that the regression is significant at $p \leq 0.10$. However, costs decision-making contributes positively to over optimism that is, better level of costs decision-making correspondent to higher level of managing cost overrun due to over optimism. Though, this hypothesis must be validated by further data collection.

Table 4.133: Model summary for cost decision-making and over optimism

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate | Change Statistics | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | R Square Change | F Change | df1 | df2 | Sig. F Change |
| 1 | .165[a] | .027 | .017 | 1.162 | .027 | 2.778 | 1 | 99 | .099 |

a. Predictors: (Constant), DM

Source: SPSS output

Table 4.134: ANOVA

**ANOVA[a]**

| Model | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | 3.748 | 1 | 3.748 | 2.778 | .099[b] |
| | Residual | 133.579 | 99 | 1.349 | | |
| | Total | 137.327 | 100 | | | |

a. Dependent Variable: Cost Overrun

b. Predictors: (Constant), DM

Source: SPSS output

Table 4.135: Coefficients for cost decision-making and over optimism

| Model | | Unstandardized Coefficients | | Standardized Coefficients | T | Sig. |
|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | |
| 1 | (Constant) | 2.259 | .385 | | 5.870 | .000 |
| | DM | .324 | .194 | .165 | 1.667 | .099 |

a. Dependent Variable: Cost Overrun

Source: SPSS output

*H11: Risk decision-making is associated with over optimism*

Similar to other hypothesis, hypothesis 11 was verified using both correlation and regression analysis. The correlation test showed that risk decision-making and cost overrun due to over optimism were weakly positively related r (101) = 0.093, and that this association was not significant, $p > 0.05$. The regression was also not significant, F (1, 99) = .517, p = 0.474, $R^2 = 0.005$. However, risk decision-making positively influence cost overrun due to over optimism, that is, higher quality level of risk decision-making correspond to a higher level of managing cost overrun induced by over optimism, though, this hypothesis must be authenticated by further data collection.

Table 4.136: Model summary of risk decision-making and over optimism

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate | Change Statistics | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | R Square Change | F Change | df1 | df2 | Sig. F Change |
| 1 | .072[a] | .005 | -.005 | 1.175 | .005 | .517 | 1 | 99 | .474 |

a. Predictors: (Constant), Risk

Source: SPSS output

Table 4.137: ANOVA

| Model | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | .713 | 1 | .713 | .517 | .474[b] |
| | Residual | 136.613 | 99 | 1.380 | | |
| | Total | 137.327 | 100 | | | |

a. Dependent Variable: Cost Overrun

b. Predictors: (Constant), Risk

Source: SPSS output

Table 4.138: Coefficient for risk decision-making and over optimism

| Model | | Unstandardized Coefficients | | Standardized Coefficients | T | Sig. |
|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | |
| 1 | (Constant) | 2.650 | .329 | | 8.054 | .000 |
| | Risk | .120 | .167 | .072 | .719 | .474 |

a. Dependent Variable: Cost Overrun

Source: SPSS output

The study result found not statistical relationship between risk decision-making and over optimism and hence it is not necessary to check the relationship between cognitive biases and risk decision-making, as even if a connection is established no impact of cognitive biases would be observed on over optimism. Cost decision-making was found to have a significant positive impact on over optimism hence the following hypothesis to gauge the relationship between cognitive biases constructs and cost decision-making variable.

*H12: Controllability cognitive bias is associated cost decision-making*

Hypothesis 12 test using both correlation and simple regression. The correlation test showed that controllability and costs decision-making were weakly negatively related r (101) = -.111, and that this association was not significant ($p > 0.05$). Simple regression analysis was used to test whether or not controllability predicts cost decision-making. The test results indicated that the regression is not significant at 0.05 though significant at 0.10, $F(1, 99) = 1.616$, $p = 0.207$, $R^2 = .016$. Further, controllability contributes negatively to cost decision-making, that is, greater level of controllability correspond to ineffective cos decision-making. This hypothesis must be validated by further data collection. Tables below display the regression test outcomes.

Table 4.139: Model summary for controllability and cost decision-making

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate | Change Statistics | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | R Square Change | F Change | df1 | df2 | Sig. F Change |
| 1 | .127[a] | .016 | .006 | .597 | .016 | 1.616 | 1 | 99 | .207 |

a. Predictors: (Constant), Controllability

Source: SPSS output

Table 4.140: ANOVA

| Model | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | .575 | 1 | .575 | 1.616 | .207[b] |
| | Residual | 35.227 | 99 | .356 | | |
| | Total | 35.802 | 100 | | | |

a. Dependent Variable: DM

b. Predictors: (Constant), Controllability

Source: SPSS output

Table 4.141: Coefficient summary for controllability and cost decision-making

| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. |
|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | |
| 1 | (Constant) | 2.261 | .297 | | 7.622 | .000 |
| | Controllability | -.101 | .079 | -.127 | -1.271 | .207 |

a. Dependent Variable: DM

Source: SPSS output

*H13: Availability cognitive bias is associated with cost decision-making*

The hypothesis was evaluated using both correlation analysis. The correlation test showed that availability and cost decision-making were weakly positively related r (101) = -.203, and that this association was significant ($p < 0.05$). The regression was also significant, F (1, 99)= 6.118, p = 0.015, $R^2$ = .058. Additionally, availability negatively influence cost decision-making, that is, greater level of availability correspond to ineffective cost decision-making. Tables below display the regression test outcomes.

Table 4.142: Model summary for availability and over optimism

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate | Change Statistics | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | R Square Change | F Change | df1 | df2 | Sig. F Change |
| 1 | .241[a] | .058 | .049 | .584 | .058 | 6.118 | 1 | 99 | .015 |

a. Predictors: (Constant), Availability

Source: SPSS output

Table 4.143: ANOVA

| Model | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | 2.084 | 1 | 2.084 | 6.118 | .015[b] |
| | Residual | 33.718 | 99 | .341 | | |
| | Total | 35.802 | 100 | | | |

a. Dependent Variable: DM, b. Predictors: (Constant), Availability

Source: SPSS output

Table 4.144: Coefficient summary for availability and cost decision-making

| Model | | Unstandardized Coefficients | | Standardized Coefficients | T | Sig. |
|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | |
| 1 | (Constant) | 2.624 | .302 | | 8.689 | .000 |
| | Availability | -.188 | .076 | -.241 | -2.474 | .015 |

a. Dependent Variable: DM

Source: SPSS output

*H14: Anchoring cognitive bias is associated with cost decision-making*

Test to this hypothesis correlation analysis between anchoring and cost decision-making was conducted. The test showed that there was a negative relationship between these variables r(101) = - .388. The test was significant (p = .000). Similarly, regression results were significant F (1, 99)= 15.522, p = .000, $R^2$ = .136.Also, anchoring contributes negatively to cost decision-making, that is, greater level of anchoring correspond to ineffective cost decision-making. Tables below display the regression test outcomes.

Table 4.145: Model summary for anchoring and cost decision-making

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate | Change Statistics | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | R Square Change | F Change | df1 | df2 | Sig. F Change |
| 1 | .368[a] | .136 | .127 | .559 | .136 | 15.522 | 1 | 99 | .000 |

a. Predictors: (Constant), Anchoring

Source: SPSS output

Table 4.146: ANOVA

| Model | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | 4.852 | 1 | 4.852 | 15.522 | .000[b] |
| | Residual | 30.950 | 99 | .313 | | |
| | Total | 35.802 | 100 | | | |

a. Dependent Variable: DM

b. Predictors: (Constant), Anchoring

Source: SPSS output

Table 4.147: Coefficients for anchoring and cost decision-making

| Model | | Unstandardized Coefficients | | Standardized Coefficients | T | Sig. |
|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | |
| 1 | (Constant) | 2.941 | .272 | | 10.803 | .000 |
| | Anchoring | -.283 | .072 | -.368 | -3.940 | .000 |

a. Dependent Variable: DM

Source: SPSS output

*H15: Conformation cognitive bias is associated with cost decision-making*

Test to this hypothesis correlation analysis between conformation and cost decision-making was conducted. The test showed that there was a negative association between these variables but not significant r (101) = - 0.152, $p > 0.05$. Similarly, the regression results were not significant F (1, 99)= 2.153, p = .145, $R^2$ = .021. Tables below display the regression test outcomes.

Table 4.148: Model summary for conformation and cost decision-making

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate | Change Statistics | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | R Square Change | F Change | df1 | df2 | Sig. F Change |
| 1 | .146[a] | .021 | .011 | .595 | .021 | 2.153 | 1 | 99 | .145 |

a. Predictors: (Constant), Conformation

Source: SPSS output

Table 4.149: ANOVA

| Model | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | .762 | 1 | .762 | 2.153 | .145[b] |
| | Residual | 35.040 | 99 | .354 | | |
| | Total | 35.802 | 100 | | | |

a. Dependent Variable: DM

b. Predictors: (Constant), Conformation

Source: SPSS output

Table 4.150: Coefficients for conformation and cost decision-making

| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. |
|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | |
| 1 | (Constant) | 2.424 | .368 | | 6.590 | .000 |
| | Conformation | -.138 | .094 | -.146 | -1.467 | .145 |

a. Dependent Variable: DM

Source: SPSS output

These results does not support hypothesis 15 in that conformation does not negatively influence cost decision-making, though it shows greater level of conformation correspond to a level of cost overrun in mega projects due to over optimism. This hypothesis must be validated by further data collection.

*H16: Cognitive dissonance cognitive bias is associated with cost decision-making*

Hypothesis 16 was tested using both correlation and simple regression. The correlation test showed that cognitive dissonance and cost decision-making were negatively related r (101) = - 0.018, and that this association was not significant ($p > 0.05$). Regression analysis was also conducted to test whether or not cognitive dissonance predicted cost decision-making. The results are shown in the following tables. This regression was not significant, $F(1,99) = .368$, $p = .545$, adjusted $R^2 = 0.004$. The results also showed cognitive dissonance does not influence cost decision-making ($p > 0.05$). These findings do not support this hypothesis. Although the results indicate, cognitive dissonance is negatively related to cost decision-making in that, lower levels of dissonance correspondents to effective cost decision-making in mega projects. This hypothesis must be validated by further data collection.

Table 4.151: Model summary for cognitive dissonance and cost decision-making

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate | Change Statistics | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | R Square Change | F Change | df1 | df2 | Sig. F Change |
| 1 | .061[a] | .004 | -.006 | .600 | .004 | .368 | 1 | 99 | .545 |

a. Predictors: (Constant), Cognitive Dissonance

Source: SPSS output

Table 4.152: ANOVA

| Model | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | .133 | 1 | .133 | .368 | .545[b] |
| | Residual | 35.669 | 99 | .360 | | |
| | Total | 35.802 | 100 | | | |

a. Dependent Variable: DM

b. Predictors: (Constant), Cognitive Dissonance

Source: SPSS output

Table 4.153: Coefficients for cognitive dissonance and cost decision-making

| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. |
|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | |
| 1 | (Constant) | 2.001 | .191 | | 10.452 | .000 |
| | Cognitive Dissonance | -.037 | .062 | -.061 | -.607 | .545 |

a. Dependent Variable: DM

Source: SPSS output

*H17: Dread cognitive bias is associated with cost decision-making*

Hypothesis 17 was checked using both correlation and simple regression. The correlation test showed that dread and cost decision-making were negatively related r (101) = - .135, and that this association was not significant at $p > 0.10$. Regression analysis was also conducted to test whether or not dread influenced cost decision-making. The results are shown in the following tables. This regression was significant at $p \leq 0.10$, F (1,99) = 3.221, p = 0.076, $R^2 = 0.032$. The results also showed dread significantly influence cost decision-making. These findings support this hypothesis. More, the influence is negative in that, greater levels of dread correspond to ineffective cost decision-making.

Table 4.154: Model summary for dread and cost decision-making

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate | Change Statistics | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | R Square Change | F Change | df1 | df2 | Sig. F Change |
| 1 | .178[a] | .032 | .022 | .592 | .032 | 3.221 | 1 | 99 | .076 |

a. Predictors: (Constant), Dread

Source: SPSS output

Table 4.155: ANOVA

| Model | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | 1.128 | 1 | 1.128 | 3.221 | .076[b] |
| | Residual | 34.674 | 99 | .350 | | |
| | Total | 35.802 | 100 | | | |

a. Dependent Variable: DM

b. Predictors: (Constant), Dread

Source: SPSS output

Table 4.156: Coefficients for dread and cost decision-making

| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. |
|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | |
| 1 | (Constant) | 2.240 | .203 | | 11.031 | .000 |
| | Dread | -.118 | .066 | -.178 | -1.795 | .076 |

a. Dependent Variable: DM

Source: SPSS output

*H18: Familiarity cognitive bias is associated with cost decision-making*

To test to this hypothesis, correlation analysis between familiarity and cost decision-making was conducted. The test showed that the relationship between these variables was negative and significant $r (101) = -.261$, $p < 0.01$. Similarly, the regression results were significant $F (1, 99) = 7.889$, $p = 0.006$, $R^2 = 0.074$. Tables below display the regression test outcomes. These results support this hypothesis in that familiarity cognitive biases influence cost decision-making. Familiarity was found to be negatively related to cost decision-making that is, greater level of familiarity corresponds to ineffective cost decision-making.

Table 4.157: Model summary for familiarity and cost decision-making

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate | Change Statistics | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | R Square Change | F Change | df1 | df2 | Sig. F Change |
| 1 | .272[a] | .074 | .064 | .579 | .074 | 7.889 | 1 | 99 | .006 |

a. Predictors: (Constant), Familiarity

Source: SPSS output

Table 4.158: ANOVA

| Model | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| | Regression | 2.642 | 1 | 2.642 | 7.889 | .006[b] |
| 1 | Residual | 33.160 | 99 | .335 | | |
| | Total | 35.802 | 100 | | | |

a. Dependent Variable: DM

b. Predictors: (Constant), Familiarity

Source: SPSS output

Table 4.159: Coefficients for familiarity and cost decision-making

| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. |
|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | |
| 1 | (Constant) | 2.840 | .343 | | 8.287 | .000 |
| | Familiarity | -.252 | .090 | -.272 | -2.809 | .006 |

a. Dependent Variable: DM

Source: SPSS output

*H19: Optimism cognitive bias is associated with cost decision-making*

Hypothesis 19 was tested for both correlation and regression analysis between optimism and cost decision-making. The test showed that the association is negative and not significant $r (101) = -.067, p > 0.05$. Similarly, the regression results were not significant $F (1, 99) = .553, p = 0.467, R^2 = 0.005$. Tables below display the regression test outcomes. These results does not support this hypothesis in that optimism cognitive biases negatively influence cost decision-making, that is higher level of optimism correspond to ineffective cost decision-making. The negative relationship must be supported by further data collection.

Table 4.160: Model summary for optimism and cost decision-making

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate | Change Statistics | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | R Square Change | F Change | df1 | df2 | Sig. F Change |
| 1 | .073[a] | .005 | -.005 | .600 | .005 | .533 | 1 | 99 | .467 |

a. Predictors: (Constant), Optimism

Source: SPSS output

Table 4.161: ANOVA

| Model | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | .192 | 1 | .192 | .533 | .467[b] |
| | Residual | 35.610 | 99 | .360 | | |
| | Total | 35.802 | 100 | | | |

a. Dependent Variable: DM

b. Predictors: (Constant), Optimism

Source: SPSS output

Table 4.162: Coefficients for optimism and cost decision-making

| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. |
|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | |
| 1 | (Constant) | 2.059 | .237 | | 8.675 | .000 |
| | Optimism | -.050 | .068 | -.073 | -.730 | .467 |

a. Dependent Variable: DM

Source: SPSS output

*H20: Venturesomeness cognitive bias is associated with cost decision-making*

Hypothesis 20 was tested using both correlation and simple regression. The correlation test showed that venturesome and cost decision-making were weakly positively related r (101)= -.156, and that this association was not significant, $p > 0.05$. Simple regression analysis was used to test whether or not venturesome influences cost decision-making. The test results indicated that the regression is significant, $F (1, 99) = 4.371$, $p = 0.039$, $R^2 = 0.042$. Tables below display the regression test outcomes. However, venturesome contributes negatively to cost decision-making that is, greater level of venturesome correspond to inefficient cost decision-making.

Table 4.163: Model summary for venturesomeness and cost decision-making

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate | Change Statistics | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | R Square Change | F Change | df1 | df2 | Sig. F Change |
| 1 | .206[a] | .042 | .033 | .589 | .042 | 4.371 | 1 | 99 | .039 |

a. Predictors: (Constant), Venturesomeness

Source: SPSS output

Table 4.164: ANOVA

| Model | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | 1.514 | 1 | 1.514 | 4.371 | .039[b] |
| | Residual | 34.288 | 99 | .346 | | |
| | Total | 35.802 | 100 | | | |

a. Dependent Variable: DM

b. Predictors: (Constant), Venturesomeness

Source: SPSS output

Table 4.165: Coefficients for venturesomeness and cost decision-making

| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. |
|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | |
| 1 | (Constant) | 2.693 | .388 | | 6.941 | .000 |
| | Venturesomeness | -.211 | .101 | -.206 | -2.091 | .039 |

a. Dependent Variable: DM

Source: SPSS output

The study then analysed the influence of the demographics on over optimism.

*Hypothesis 21: Gender is associated with over optimism*

Hypothesis 21 was verified using correlation and regression analysis. The correlation test showed that gender and cost overrun due to over optimism were weakly negatively related r (101) = -.136, and that this association was not significant, $p > 0.05$. The regression was also not significant, $F (1, 99) = 1.721$, $p = 0.193$, $R^2 = 0.017$. However, gendernegatively influence cost overrun due to over optimism, that is, lower gender balance correspond to a higher level of cost overrun induced by over optimism, though, this hypothesis must be authenticated by further data collection.

Table 4.166: Model summary for gender and overoptimism

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate | Change Statistics | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | R Square Change | F Change | df1 | df2 | Sig. F Change |
| 1 | .131[a] | .017 | .007 | 1.168 | .017 | 1.721 | 1 | 99 | .193 |

a. Predictors: (Constant), Gender

Source: SPSS output

Table 4.167: ANOVA

| Model | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | 2.346 | 1 | 2.346 | 1.721 | .193[b] |
| | Residual | 134.981 | 99 | 1.363 | | |
| | Total | 137.327 | 100 | | | |

a. Dependent Variable: Cost Overrun

b. Predictors: (Constant), Gender

Source: SPSS output

Table 4.168: Coefficients for gender and over optimism

| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. |
|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | |
| 1 | (Constant) | 3.324 | .364 | | 9.125 | .000 |
| | Gender | -.305 | .232 | -.131 | -1.312 | .193 |

a. Dependent Variable: Cost Overrun

Source: SPSS output

*Hypothesis 22: Culture is associated with over optimism*

Hypothesis 22 was verified using correlation and regression analysis. The correlation test showed that culture and cost overrun due to over optimism were weakly positively related r (101) = .115, and that this association was not significant, $p > 0.05$. The regression was also not significant, F (1, 99) = 1.246, p = 0.267, $R^2 = 0.012$. However, culture positively influence cost overrun due to over optimism, that is, lower culture balance correspond to a higher level of cost overrun induced by over optimism, though, this hypothesis must be authenticated by further data collection.

Table 4.169: Model summary for culture and over optimism

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate | Change Statistics | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | R Square Change | F Change | df1 | df2 | Sig. F Change |
| 1 | .111[a] | .012 | .002 | 1.170 | .012 | 1.246 | 1 | 99 | .267 |

a. Predictors: (Constant), Culture

Source: SPSS output

Table 4.170: ANOVA

| Model | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | 1.707 | 1 | 1.707 | 1.246 | .267[b] |
| | Residual | 135.620 | 99 | 1.370 | | |
| | Total | 137.327 | 100 | | | |

a. Dependent Variable: Cost Overrun

b. Predictors: (Constant), Culture

Source: SPSS output

Table 4.171: Coefficients for culture and over optimism

| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. |
|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | |
| 1 | (Constant) | 2.542 | .317 | | 8.021 | .000 |
| | Culture | .184 | .164 | .111 | 1.116 | .267 |

a. Dependent Variable: Cost Overrun

Source: SPSS output

*Hypothesis 23: Company size is associated with over optimism*

Hypothesis 23 was verified using correlation and regression analysis. The correlation test showed that culture and cost overrun due to over optimism were weakly negatively related r (101) = -.066, and that this association was not significant, $p > 0.05$. The regression was also not significant, $F (1, 99) = .562$, $p = 0.455$, $R^2 = 0.006$.

However, company size negatively influence cost overrun due to over optimism, that is, large company size corresponds to a lower level of cost overrun induced by over optimism, though, this hypothesis must be authenticated by further data collection.

Table 4.172: Model summary for company size and cost overrun

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate | Change Statistics | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | R Square Change | F Change | df1 | df2 | Sig. F Change |
| 1 | .075[a] | .006 | -.004 | 1.174 | .006 | .562 | 1 | 99 | .455 |

a. Predictors: (Constant), Company Size

Source: SPSS output

Table 4.173: ANOVA

| Model | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| | Regression | .775 | 1 | .775 | .562 | .455[b] |
| 1 | Residual | 136.552 | 99 | 1.379 | | |
| | Total | 137.327 | 100 | | | |

a. Dependent Variable: Cost Overrun

b. Predictors: (Constant), Company Size

Source: SPSS output

Table 4.174: Coefficients for company size and over optimism

| Model | Unstandardized Coefficients | Standardized Coefficients | t | Sig. |
|---|---|---|---|---|

| | | B | Std. Error | Beta | | |
|---|---|---|---|---|---|---|
| 1 | (Constant) | 3.018 | .228 | | 13.231 | .000 |
| | Company Size | -.071 | .094 | -.075 | -.749 | .455 |

a. Dependent Variable: Cost Overrun

Source: SPSS output.

*Hypothesis 24: Work experience is associated with over optimism*

Hypothesis 24 was tested using both correlation and simple regression. The correlation test showed that work experience and cost overrun due to over optimism were weakly positively related r (101) = .172, and that this association was significant, $p \leq 0.10$. Also, simple regression analysis was used to test whether or not work experience predicts cost overrun due to over optimism. The test results indicated that the regression is significant at $p \leq 0.10$, $F (1, 99) = 3.347$, $p = 0.070$, $R^2 = 0.033$. Tables below display the regression test outcomes. However, work experience contributes positively to over optimism that is, greater level of work experience correspondent to higher level of managing project cost overrun due to over optimism.

Table 4.175: Model summary for work experience and over optimism

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate | Change Statistics | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | R Square Change | F Change | df1 | df2 | Sig. F Change |
| 1 | .181[a] | .033 | .023 | 1.158 | .033 | 3.347 | 1 | 99 | .070 |

a. Predictors: (Constant), Work Experience

Source: SPSS data

Table 4.176: ANOVA

| Model | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | 4.491 | 1 | 4.491 | 3.347 | .070[b] |
| | Residual | 132.836 | 99 | 1.342 | | |
| | Total | 137.327 | 100 | | | |

a. Dependent Variable: Cost Overrun

b. Predictors: (Constant), Work Experience

Source: SPSS output

Table 4.177: Coefficients for work experience and over optimism

| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. |
|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | |
| 1 | (Constant) | 2.380 | .292 | | 8.143 | .000 |
| | Work Experience | .158 | .086 | .181 | 1.829 | .070 |

a. Dependent Variable: Cost Overrun

Source: SPSS output

*Hypothesis 25: Job position is associated with over optimism*

Hypothesis 25 was tested using both correlation and simple regression. The correlation test showed that job position and cost overrun due to over optimism were weakly negatively related r (101) = -.038, and that this association was not significant, $p > 0.10$. Simple regression analysis was used to test relationship between job position and cost overrun due to over optimism. The test results indicated that the regression is not significant, F (1, 99) = .014, p = 0.906, $R^2$ = 0.000. Tables below display the regression test outcomes. More, job position contributes negatively to over optimism that is, higher level of job position correspond to lower level of managing project cost overrun due to over optimism.

Table 4.178: Model summary for job position and over optimism

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate | Change Statistics | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | R Square Change | F Change | df1 | df2 | Sig. F Change |
| 1 | .012[a] | .000 | -.010 | 1.178 | .000 | .014 | 1 | 99 | .906 |

a. Predictors: (Constant), Job Position

Source: SPSS output

Table 4.179: ANOVA

| Model | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | .019 | 1 | .019 | .014 | .906[b] |
| | Residual | 137.307 | 99 | 1.387 | | |
| | Total | 137.327 | 100 | | | |

a. Dependent Variable: Cost Overrun

b. Predictors: (Constant), Job Position

Source: SPSS output

Table 4.180: Coefficient for job position and over optimism

| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. |
|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | |
| 1 | (Constant) | 2.900 | .273 | | 10.639 | .000 |
| | Job Position | -.009 | .073 | -.012 | -.118 | .906 |

a. Dependent Variable: Cost Overrun

Source: SPSS output

### *6.6.7 Summary*

The relationship between cost decision-making, risk decision-making, numerous cognitive biases and project cost overrun due to over optimism was conducted using simple linear regression among the dependent and independent variables. The regression model was initially tested for the model's assumptions, which included normality test, linearity test, multicollinearity, homoscedasticity, and correlation analysis before applying the model. The study tested 16 hypotheses. Majority of the hypothesis indicated no significance and only four showed significance. Among the main variables in the study, controllability, dread, and costs decision-making influenced projects cost overrun due to over optimism while the rest showed no influence. Controllability and costs decision-making elements reflected positive influence whereas dread factor was negative. Among the demographic variables, only work experience was found to have a positively influence on over optimism.

*6.7 Testing the combined influence using hierarchical regression*

This research was set to address the question: does cognitive basis, cost decision-making and risk decision-making in mega projects account for a significant amount of variability in cost overrun due to over optimism. Over and above, the research accounted for the influence of demographic characteristics of project managers on cost overrun due to over optimism. The model adopted for the hierarchical regression is shown in Figure 26 below.

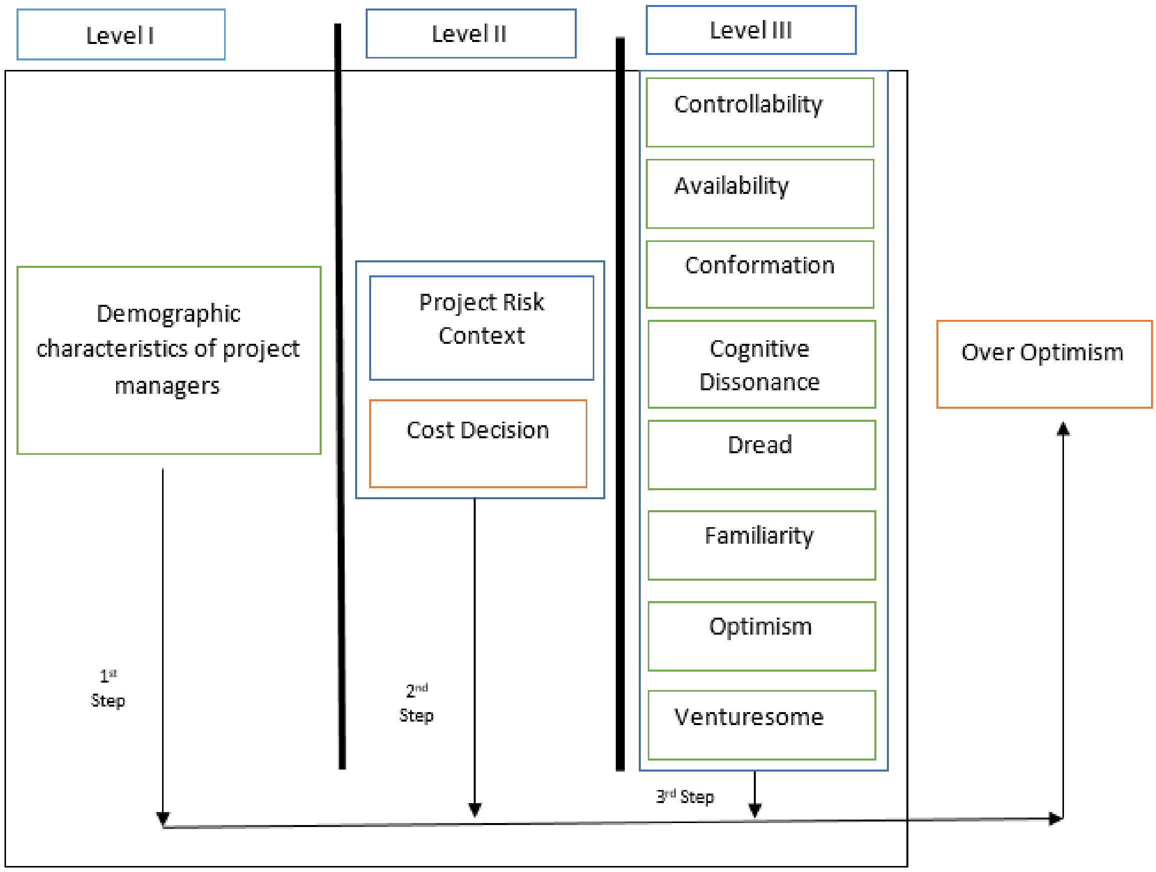


Figure 26: Hierarchical Model

Before carrying the steps shown in the above figure several pre-analysis and validity procedures were carried out. these are reported in the following section.

**Testing for Normality**

Normality verification or testing is necessary to make sure the research data set conform to a normal distribution. Test is also essential for selecting a model for data analysis. Haire et al (2006) for example, explained that normalities is associated with the shape of the data distribution. There are several ways to test the normality of metric variables. Of the most widely report methods is to use the levels of skewness and kurtosis to assess the distribution shape of the research variables. For example, it well recognised that skewness provides a sign of a variable distribution is symmetrical ((Hair et al., 2006). Similarly, Kurtosis provided an indication of the variable distribution peakedness or otherwise. The critical values of skewness and kurtosis depend on the level of the chosen statistical significance. For example, at 0.01 significant level skewness and kurtosis values should not be more that +/- 2.58 (Hair et al., 2006). The author also indicated skewness and kurtosis values +/- 1.96 at 0.05 significance level are acceptable. Skewness and kurtosis values shown in table xx indicated none of the research variables are outside the range +/-2.58. Therefore, the distribution shape of these study variables is considered normal in relation to skewness and kurtosis (Hair et al., 2006)

Table 4.181: Skewness and Kurtosis Results

| | **Skewness** | **Kurtosis** |
|---|---|---|
| Costs_decision | .065 | -.060 |
| Risk_decision | -.015 | -.649 |
| Controllability | -.440 | .556 |
| Availability | -.928 | 2.413 |
| conformation | -.554 | .992 |
| Dissonance | .349 | -.412 |
| dread | .013 | -.579 |
| Optimism | -.575 | -.752 |
| Venturesome | -1.211 | 1.962 |
| Over_optimism | .030 | -.411 |

**Testing for Linearity**

The linearity test is associated with the idea that Y and X variables are related by a mathematical equation , which Y and X change in a leaner manner. The importance for checking research data for linearity lies in the fact that most the uninervate, bivariate and inferential statistics require data to conform to linearity assumption. For example, the regression analysis the linearity test confirm if the relationship between the independent and variables is linear or otherwise. According to F i e l d (2016), this research carried several test of simple linear regression on each of the research constructs. Results, that is residuals and normality probability P-P plots, from these tests were then used to examine linearity. The results are shown in Appendix xx. The P-P plots show that the residual graphs are nearly a straight line over the diagonal fitting axis. This demonstrate that the randomness of the residuals is observed

**Testing for Multicollinearity – Tolerance and VIF**

Multicollinearity occurs when tow or several independent variables or predictors in a regression model are highly correlated (Hair et al. 2006 and Field 2016). The first step in testing multicollinearity is to check the level of correlation between the model independent variables. It is reported (Field 2016) that if the level of correlation between independent variables is less than 0.8, then multicollinearity is a concern. Field (2016) also suggested to use tolerance and variance inflation factor (VIF) indictor to examine the presence of collinearity. If the value of VIF is less than ten (other authors suggested a higher value than 10) and tolerance value is between 0.1 and 1 then this indicate the absence of multicollinearity. Table below demonstrates that VIF and tolerance are within the specified limits. Thus, points out to the absence of multicollinearity in this study data.

Table 4.182: Collinearity Results

| | Tolerance | VIF |
|---|---|---|
| Costs_decision | .681 | 1.468 |
| Risk_decision | .611 | 1.637 |
| Controllability | .663 | 1.507 |
| Availability | .469 | 2.130 |
| conformation | .573 | 1.745 |
| Dissonance | .573 | 1.744 |
| dread | .464 | 2.157 |
| Optimism | .679 | 1.473 |
| Venturesome | .705 | 1.419 |

**Testing Homoscedasticity verification**

Homoscedasticity assumption is set to examine if there is equal levels of variance between the dependent and across a series of independent variables. The assumption is observed if the variance around the regression line is the identical for all values of the independent variable. Similarly, to Hair et al (2006), Field (2016) and others, this research uses scatterplots to versify the homoscedasticity assumption. Accordingly, Scatter plots of standardised residual were produce form all the research depend and independent variables, results as shown in Appendix XX. The results showed that there are no visible patterns of residuals. Thus, homoscedasticity assumption is not violated.

**Testing for** correlation

The purpose of test to confirm of the association between cognitive biases and project cost, and risk decision making. The test will also confirm whether the three constructs move in similar or opposite direction.

Table 4.183: Testing for Correlation

| | | Costs_decision | Risk_decision | Controllability | Availability | conformation | Dissonance | dread | Optimism | Venturesome | Over_optimism |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Spearman's rho | Costs_decision | 1.000 | .486** | -.290** | -.249* | -.294** | -.134 | -.078 | -.129 | -.222* | .206* |
| | Risk_decision | .486** | 1.000 | -.395** | -.295** | -.314** | .060 | -.041 | -.003 | -.303** | .001 |
| | Controllability | -.290** | -.395** | 1.000 | .418** | .253* | .076 | .037 | .049 | .087 | .191 |
| | Availability | -.249* | -.295** | .418** | 1.000 | .453** | .105 | .160 | .066 | .302** | .055 |
| | conformation | -.294** | -.314** | .253* | .453** | 1.000 | .163 | .307** | .231* | .279** | .115 |
| | Dissonance | -.134 | .060 | .076 | .105 | .163 | 1.000 | .581** | .377** | -.103 | -.239* |
| | dread | -.078 | -.041 | .037 | .160 | .307** | .581** | 1.000 | .525** | .051 | -.179 |
| | Optimism | -.129 | -.003 | .049 | .066 | .231* | .377** | .525** | 1.000 | .096 | .087 |
| | Venturesome | -.222* | -.303** | .087 | .302** | .279** | -.103 | .051 | .096 | 1.000 | .027 |
| | Over_optimism | .206* | .001 | .191 | .055 | .115 | -.239* | -.179 | .087 | .027 | 1.000 |

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

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

The results in the above table show that cost Decision making in mega projects is negatively correlated with cognitive biases. Similarly, risk decision making in mega projects is negatively associated with cognitive biases. However cognitive dissonance to be positively correlated with risk taking decisions.

Correlation between research contracts and demographic variables shows that only job position and work experience are significantly correlated with over optimism and venturesome. Work experience is also negatively correlated with conformation, Dissonance, dead, optimism, project risk environment, and cost decisions. Whereas job position is negatively associated with Controllability, conformation, dread, Optimism, project risk environment, and cost decisions.

Table 4.184: Correlations

| | Venturesome | Over_optimism |
|---|---|---|
| Job Position | | .200* |
| Work Experience | .256** | |

**Regression Analysis**

Several linear regression trials were conducted to study the influence of demographic variables on over optimism phenomena in mega projects. None of the demographic variables found to have a significant influence on over optimism. Regression analysis is used to investigate the influence or dependence of cost decisions on cognitive biases. This will demonstrate the extent to which cost decisions and over optimistic outlook of mega projects depend on manager cognitive biases. the study also will draw conclusion if the project environment or context moderate the relationship between the model dependent and independent variables. The relationship this study is trying to validate is shown in figure 26.

## Hypothesis Testing

Prior to carrying out the hierarchical regression analyses, all the independent variables were subject to several assumption tests were performed on the depend and independent variables. As demonstrated on the previous section. The results showed that all the regression assumptions were observed.

*H1: Controllability cognitive bias is associated with over optimism*

Hypothesis 1 test using both correlation and simple regression. The correlation test showed that controllability and over optimism were weakly positively related r (101)= 0.191, and that this association was not significant. Also simple regression analysis was used to test whether or not controllability predicts over optimism. The test results indicated that the regression is not significant. However, controllability contributes positively to over optimism, that is greater level of controllability correspondent to higher level of over optimism. Though, this hypothesis must be validated by further data collection.

*H2: Availability cognitive bias is associated with over optimism*

Similarly, to hypothesis 2 was verified using both correlation analysis. The correlation test showed that controllability and over optimism were weakly positively related r (101) = 0.055, and that this association was not significant. The regression was not significant. However, Availability influence positively to over optimism, that is greater level of Availability correspondent to a higher level of over optimism, though, this hypothesis must be authenticated by further data collection.

*H3: Conformation cognitive bias is associated with over optimism*

Test to this hypothesis correlation analysis between conformation and over optimism was conducted. The test showed that there was significant relationship between these variables r(101) = 0.27, $p \leq 0.05$. similarly, the regression results were significant F(1, 4.42) , p = 0.038, $R^2$ = .033. Tables below display the regression test outcomes.

Table 4.185: Model Summary

**Model Summary**

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate | Change Statistics: R Square Change | F Change | df1 | df2 | Sig. F Change |
|---|---|---|---|---|---|---|---|---|---|
| 1 | .207[a] | .043 | .033 | .34786 | .043 | 4.423 | 1 | 99 | .038 |

a. Predictors: (Constant), SQconformation

Table 4.186: Coefficients

**Coefficients[a]**

| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. | 95.0% Confidence Interval for B | |
|---|---|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | | Lower Bound | Upper Bound |
| 1 | (Constant) | 1.360 | .561 | | 2.424 | .017 | .247 | 2.473 |
| | SQconformation | .276 | .131 | .207 | 2.103 | .038 | .016 | .536 |

a. Dependent Variable: SQsoveroptimism

These results support hypothesis 3 in that conformation influence positively over optimism that is greater level of conformation correspondents to a higher level of cost overrun in mega projects due to over optimism.

*H4: Dissonance cognitive bias is associated with over optimism*

Hypothesis 4 test using both correlation and simple regression. The correlation test showed that Dissonance and over optimism were positively related r (101) = 0.339, and that this association was significant at the level p ≤ 0.01. Regression analysis was also conducted to test whether or not Dissonance predicted over optimism in mega projects. The results are shown in the following tables. This regression was significant, F(1,12.845), p = 0.001, adjusted $R^2$ = 0.106. The results also showed dissonance significantly influence over optimism at level of p ≤ 0.001. These findings support hypothesis 4 in that greater levels of dissonance correspondents to a higher level of cost overrun due to over optimism in mega.

Table 4.187: Model Summary

**Model Summary**

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate | Change Statistics | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | R Square Change | F Change | df1 | df2 | Sig. F Change |
| 1 | .339[a] | .115 | .106 | .33451 | .115 | 12.845 | 1 | 99 | .001 |

a. Predictors: (Constant), SQdissonance

Table 4.188: Coefficients

**Coefficients[a]**

| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. | 95.0% Confidence Interval for B | |
|---|---|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | | Lower Bound | Upper Bound |
| 1 | (Constant) | 1.667 | .245 | | 6.793 | .000 | 1.180 | 2.153 |
| | SQdissonance | .259 | .072 | .339 | 3.584 | .001 | .115 | .402 |

a. Dependent Variable: SQsoveroptimism

*H5: Dread cognitive bias is associated with over optimism*

Hypothesis 5 test using both correlation and simple regression. The correlation test showed that Dissonance and over optimism were positively related r (101) = 0.513, and that this association was significant at the level p ≤ 0.01. Regression analysis was also conducted to test whether or not dread predicted cost overrun over optimism in mega projects. The results are shown in the following tables. This regression was significant, F(1,35.32), p = 0.000, adjusted R2 = 0.256. The results also showed dread significantly influence cost overrun over optimism at level of p ≤ 0.000. These findings support hypothesis 5 in that greater levels of dread correspondents to a higher level of cost overrun due to over optimism in mega.

Table 4.189: Coefficients

| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. | 95.0% Confidence Interval for B | |
|---|---|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | | Lower Bound | Upper Bound |
| 1 | (Constant) | 1.667 | .245 | | 6.793 | .000 | 1.180 | 2.153 |
| | SQdissonance | .259 | .072 | .339 | 3.584 | .001 | .115 | .402 |

Coefficients[a]

a. Dependent Variable: SQsoveroptimism

Table 4.190: Coefficients

| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. | 95.0% Confidence Interval for B | |
|---|---|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | | Lower Bound | Upper Bound |
| 1 | (Constant) | 1.177 | .231 | | 5.102 | .000 | .719 | 1.635 |
| | SQdread | .467 | .078 | .513 | 5.952 | .000 | .311 | .623 |

Coefficients[a]

a. Dependent Variable: SQsoveroptimism

*H6: Optimism cognitive bias is associated with over optimism*

Test to this hypothesis correlation analysis between optimism and cost overrun due to over optimism was conducted. The test showed that there was significant relationship between these variables r(101) = 1.00, p ≤ 0.00. Similarly, the regression results were significant F(1, 12.515) , p = 0.000, R2 = 1. Tables below display the regression test outcomes. These results support hypothesis 6 in that optimism biases influence positively cost overrun due to over optimism that is greater level of optimism correspondents to a higher level of cost overrun in mega projects due to over optimism.

Table 4.191: Coefficients

| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. | 95.0% Confidence Interval for B | |
|---|---|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | | Lower Bound | Upper Bound |
| 1 | (Constant) | 1.177 | .231 | | 5.102 | .000 | .719 | 1.635 |
| | SQdread | .467 | .078 | .513 | 5.952 | .000 | .311 | .623 |

Coefficients[a]

a. Dependent Variable: SQsoveroptimism

Table 4.192: Coefficients

| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. | 95.0% Confidence Interval for B | |
|---|---|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | | Lower Bound | Upper Bound |
| 1 | (Constant) | .000 | .000 | | . | . | .000 | .000 |
| | SQoptimism | 1.000 | .000 | 1.000 | . | . | 1.000 | 1.000 |

Coefficients[a]

a. Dependent Variable: SQsoveroptimism

*H7: Venturesome cognitive bias is associated with over optimism*

Hypothesis 1 test using both correlation and simple regression. The correlation test showed that Venturesome and cost overrun due to over optimism were weakly positively related r (101)= 0.112, and that this association was not significant. Also, simple regression analysis was used to test whether or not Venturesome predicts cost overrun due to over optimism. The test results indicated that the regression is not significant. However, venturesome contributes positively to over optimism, which is greater level of venturesome correspondent to higher level of over optimism. Though, this hypothesis must be validated by further data collection.

*H8: Costs decision making is associated with over optimism*

Hypothesis 8 test using both correlation and simple regression. The correlation test showed that Costs decision making and cost overrun over optimism were inversely related, r (101)= -0.089, and that this association was not significant. Also simple regression analysis was used to test whether or not Costs decision making predicts cost overrun due to over optimism. The test results indicated that the regression is not significant. However, Costs decision making contributes negatively to over optimism, that is better level of costs decision making correspondent to lower level of over optimism. Though, this hypothesis must be validated by further data collection.

*H9: Risk decision making is associated with over optimism*

Similarly, to hypothesis 8 was verified using both correlation analysis. The correlation test showed that risk decision making and cost overrun due to over optimism were weakly positively related r (101) = 0.132, and that this association was not significant. The regression was also not significant. However, risk decision making influence positively to cost overrun due to over optimism, that is lower quality level of risk decision making correspondent to a higher level of cost overrun of over optimism, though, this hypothesis must be authenticated by further data collection.

## Testing the combined influence using hierarchical regression

This research was set to address the question: does cognitive basis, cost decision making and risk decision making in mega projects account for a significant amount of variability in cost overrun due to over optimism over and above that accounted for in demographic characteristics of project managers. The results of the hierarchical regression predicting cost overrun over optimism of cost outcomes in mega projects from project manager demographic characteristics and cognitive biases decision attributes are reported in table xx

The results showed in the first step that the variance account for ($R^2$) with the for the first two project manager demographic predictors ( job position and experience) is 0.06 (adjusted $R^2$=0.041), which is significantly different from zero (F(3.145, 98) , $p< 0.05$). In the next step cost decision making scores were entered into the regression equation. The regression results were significant F(97,6.495) , p = 0.047, $R^2$ = 0.119. The change in variance accounted for (□$R^2$) was equal to 0.059 which was statistically significant increase in variance accounted for over the step one model ($F_{(98,3.145)}$, $p$<.05). In step three, cognitive biases were entered into the regression equation. The regression results were significant F(93, 4.943) , p = 0.007, $R^2$ = 0.272. The change in variance accounted for ($R^2$) was equal to 0.159, which was a statistically significant increase in variance accounted above the variability contributed by the previous predictor variables entered in step two ($F_{(93,\ 6.495)=}$ $p$<.001).

As shown in the table the two-project managers' demographic character were statistically significant. All the cognitive biases were statistically significant, although, optimism biases variable was just marginally above the significant level.

Table 4.193: Model Summary

**Model Summary[d]**

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate | Change Statistics | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | R Square Change | F Change | df1 | df2 | Sig. F Change |
| 1 | .246[a] | .060 | .041 | 4.20061 | .060 | 3.145 | 2 | 98 | .047 |
| 2 | .345[b] | .119 | .092 | 4.08757 | .059 | 6.495 | 1 | 97 | .012 |
| 3 | .523[c] | .274 | .219 | 3.79098 | .154 | 4.943 | 4 | 93 | .001 |

a. Predictors: (Constant), Job Position, Work Experience

b. Predictors: (Constant), Job Position, Work Experience, Costs_decision

c. Predictors: (Constant), Job Position, Work Experience, Costs_decision, SQoptimism, SQcontollability, SQdissonance, SQconformation

d. Dependent Variable: Over_optimism

## Table 4.194: ANOVA

**ANOVA[a]**

| Model | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | 110.995 | 2 | 55.497 | 3.145 | .047[b] |
| | Residual | 1729.223 | 98 | 17.645 | | |
| | Total | 1840.218 | 100 | | | |
| 2 | Regression | 219.517 | 3 | 73.172 | 4.379 | .006[c] |
| | Residual | 1620.701 | 97 | 16.708 | | |
| | Total | 1840.218 | 100 | | | |
| 3 | Regression | 503.665 | 7 | 71.952 | 5.007 | .000[d] |
| | Residual | 1336.553 | 93 | 14.372 | | |
| | Total | 1840.218 | 100 | | | |

a. Dependent Variable: Over_optimism

b. Predictors: (Constant), Job Position, Work Experience
c. Predictors: (Constant), Job Position, Work Experience, Costs_decision
d. Predictors: (Constant), Job Position, Work Experience, Costs_decision, SQoptimism, SQcontollability, SQdissonance, SQconformation

### *6.8 Significance of the Estimated Coefficients*

Table 4.183 below provides the coefficients for the 3 step hierarchical model. The coefficients are an estimate of how much each of the independent variables contributes to the prediction of cost overrun due over optimism. In the first step, for project managers' demographic characters, work experience was statistically significant at $p < 0.10$ while job position was not. In the second step, the significance of work experience and cost decision-making was at $p < 0.05$. In the third step, work experience was significant at $p < 0.10$, cost decision-making was significant at 0.05, and for the cognitive biases dissonance and controllability were significant at $p < 0.05$ . optimism construct was significant at $p < 0.10$. All other biases were not significant at $p < 0.05$ or $p < 0.10$.

Table 4.195: Coefficients

**Coefficients[a]**

| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. | 95.0% Confidence Interval for B | |
|---|---|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | | Lower Bound | Upper Bound |
| 1 | (Constant) | 11.684 | 1.197 | | 9.765 | .000 | 9.310 | 14.059 |
| | Work Experience | .532 | .314 | .166 | 1.696 | .093 | -.090 | 1.154 |
| | Job Position | .444 | .232 | .187 | 1.912 | .059 | -.017 | .905 |
| 2 | (Constant) | 5.582 | 2.662 | | 2.097 | .039 | .299 | 10.866 |
| | Work Experience | .593 | .306 | .185 | 1.938 | .056 | -.014 | 1.200 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Job Position | .487 | .227 | .206 | 2.149 | .034 | .037 | .937 |
| | Costs_decision | .188 | .074 | .244 | 2.549 | .012 | .042 | .334 |
| 3 | (Constant) | -16.382 | 9.536 | | -1.718 | .089 | -35.319 | 2.554 |
| | Work Experience | .585 | .289 | .183 | 2.024 | .046 | .011 | 1.159 |
| | Job Position | .563 | .211 | .238 | 2.671 | .009 | .145 | .982 |
| | Costs_decision | .256 | .074 | .332 | 3.435 | .001 | .108 | .403 |
| | SQcontollability | 3.454 | 1.700 | .198 | 2.031 | .045 | .077 | 6.830 |
| | SQconformation | 2.571 | 1.594 | .159 | 1.613 | .110 | -.593 | 5.736 |
| | SQdissonance | -2.949 | .885 | -.319 | -3.331 | .001 | -4.707 | -1.191 |
| | SQoptimism | 2.173 | 1.161 | .179 | 1.872 | .064 | -.132 | 4.478 |

a. Dependent Variable: Over_optimism

Examining Residuals using Scatter Plots
This is for examining the fact the developed mode does not violate homoscedasticity, independence and normality of the residuals assumptions . The residuals' statistics results obtained from the regression simulation are illustrated in the Table below shows that the residual mean is zero.
Table 4.196: Residual Statistics

**Residuals Statistics[a]**

| | Minimum | Maximum | Mean | Std. Deviation | N |
|---|---|---|---|---|---|
| Predicted Value | 7.7777 | 18.7379 | 14.3267 | 2.24425 | 101 |
| Residual | -9.51427 | 9.13701 | .00000 | 3.65589 | 101 |
| Std. Predicted Value | -2.918 | 1.966 | .000 | 1.000 | 101 |
| Std. Residual | -2.510 | 2.410 | .000 | .964 | 101 |

a. Dependent Variable: Over optimism

The developed model is also tested for homoscedasticity. As demonstrated in the figure below that there is no systematic pattern. The results are randomly spread.

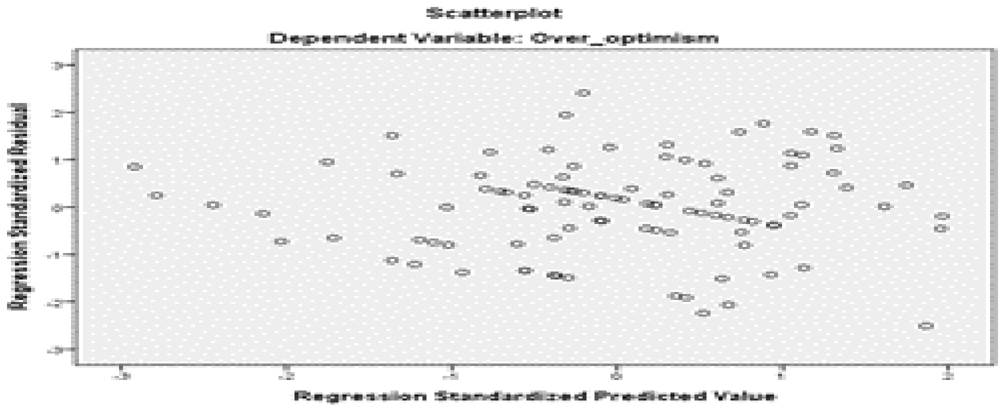


Figure 27: Scatter Plot Results

Source: Created by Student

Next the normality of the residuals was also assessed using a histogram of the frequency of the standardised residuals. The figure below demonstrated that the frequency of the standardised residuals follows the normal curve

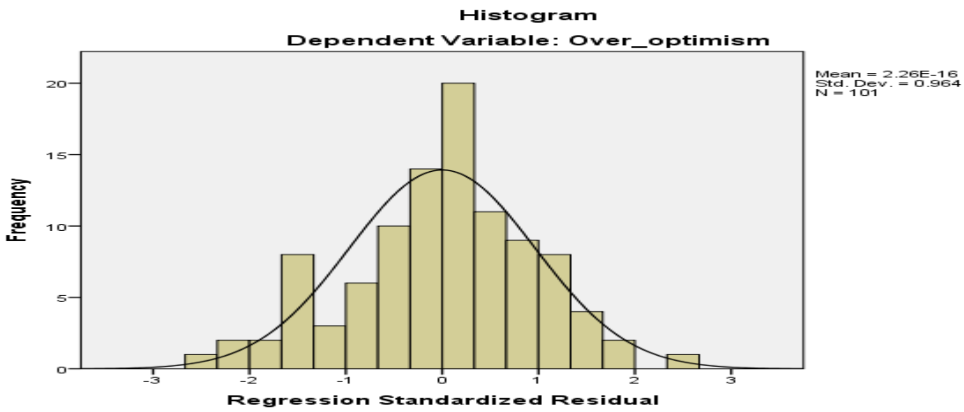


Figure 28: Normality Results

Source: Created by Student

The last validity test of the regression model is to check  the PP plot (figure below) to check the normality assumption is not violated. The figures showed the data points follow the straight line in most the graph regions

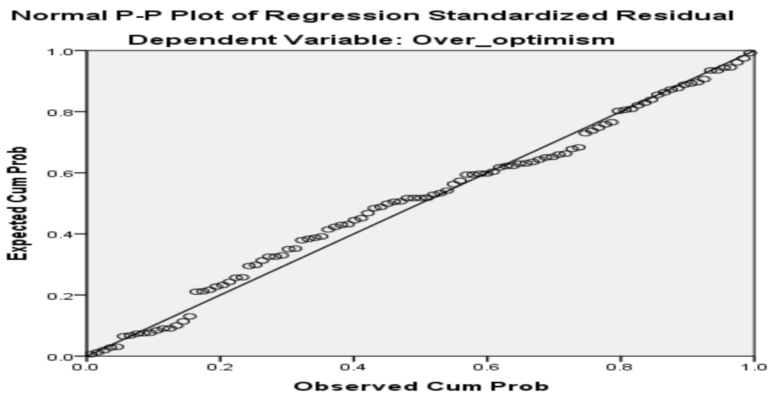


Figure 29: Regression Graph

Source: Created by Student

# Chapter Seven: Discussion of the Findings

## *7.1 Introduction*

The ultimate aim of this study, as presented in chapter 1, was to investigate the impact of cognitive biases on decision making in mega projects. In the process of achieving this overall aim, insights on the subsets of the study area were also sought. Such insights include determining whether there are links between cognitive biases and increase in the size and scope of mega projects; and the identification of the characteristics of mega projects that lead to cost overruns. The study also presented investigations on the impact of various attributes of key project stakeholders such as engineers, project managers, directors, CEO's and others, on project cost overruns. These other factors include  demographic characteristics, cognitive biases attributes, cost decision making criteria, risk decision making criteria, and over optimism in mega projects within UAE. Low performance in mega projects caused by cost overruns is a recurrent and worldwide occurrence and UAE is no exception prompting attention in this research to survey the causes that have a consequence on the cost overruns due to over optimism (Pozzi, 2016).

According to Ramos (2019), personality is a major contributing factor to a person's cognitive style with high influence on the person's decision-making approach implying that personality traits impact on people's opinions and therefore, personality is linked to various cognitive biases shown by people. In mega projects, the commonly noted bias triggering cost overruns is over optimism bias, which is known to enhance undervaluing of costs. It also focuses on overrating the paybacks of mega projects to support project authorization and execution. In this scenario it is thus affected by personality traits (Pozzi, 2016). Excessive optimism bias termed as over optimism makes a mega project attractive and consequently, after the project is favored for implementation; the actual cost is realized causing cost overruns due to over optimism (Erol, Dikmen, Atasoy and Birgonul, 2018). Moreover, the main stakeholders are tasked with making sure the cost and risk decisions are appropriate such that these decisions will ensure completion of the mega project and will provide benefits in the future, as the initial cost is high to quit the project.

The chapter discusses the main research questions and subjects analyzed throughout this study. First, this section provides an argument on the outcomes from review of previous literature, then by an argument on the outcome from the survey and finally, the research findings from the ANOVA and regression analysis will be explained. All through this chapter, the findings are discussed based on theory and application.

*7.2 Hypotheses*

The following hypotheses were set in the project.

H01: There is no statistically significant difference between the respondents' perceptions on ‘cost decision making in mega projects based on job position, experience and culture’

HA1: There is statistically significant difference between the respondents' perceptions on ‘cost decision making in mega projects based on job position, experience and culture’.

H02: There is no statistically significant difference between the respondents' perceptions on ‘project risk factors in mega projects based on job holder, experience and culture’.

HA2: There is statistically significant difference between the respondents' perceptions on ‘project risk factors in mega projects based on job holder, experience and culture’.

H03: No statistically significant difference exists between the respondents' perceptions on ‘personality traits that influence project cost decisions based on job holder, experience and culture’.

HA3: There is statistically significant difference between the respondents' perceptions on ‘personality traits that influence project cost decisions based on job holder, experience and culture’.

H04: There is no statistically significant difference between the respondents' perceptions on ‘the effect of over optimism on cost overrun’.

HA4: There is statistically significant difference between the respondents' perceptions on ‘the effect of over optimism on cost overrun’.

H05: There is statistically significant relationship between cognitive biases (controllability, availability, anchoring, confirmation, cognitive dissonance, dread, familiarity, optimism and venturesomeness) and ‘the effect of over optimism on cost overrun’.

HA5: There is no statistically significant relationship between cognitive biases (controllability, availability, anchoring, confirmation, cognitive dissonance, dread, familiarity, optimism and venturesomeness) and the effect of over optimism on cost overrun’.

H06: There is no statistically significant relationship between decision-making (cost and risk) and ‘the effect of over optimism on cost overrun’.

HA6: There is statistically significant relationship between decision making (cost and risk) and the effect of over optimism on cost overrun'.

H07: There is no statistically significant relationship between cognitive biases (controllability, availability, anchoring, confirmation, cognitive dissonance, dread, familiarity, optimism and venturesomeness) and 'cost decision making in mega projects'.

HA7: There is statistically significant relationship between cognitive biases (controllability, availability, anchoring, confirmation, cognitive dissonance, dread, familiarity, optimism and venturesomeness) and 'cost decision making in mega projects'.

## *7.3 Determinants of Over Optimism in Mega Projects*

### *7.3.1 Research Question 1:*

What are the cognitive biases in decision making that can lead to cost overrun in mega projects?

The research question scrutinizes the determinants of cost overrun due to over optimism from four dimensions: firstly, from the view point of project manager's demographic attributes; secondly, from the notion that cognitive biases are influenced by personality traits; thirdly, from the view point of cost decision making, and lastly, from the notion of risk decision making that could yield over optimism and thirdly from the notion of risk decisions that might sway over optimism. The research question objective is achieved via exploration of previous literature.

*Demographic Attributes Relating to Cost Overrun in Mega Projects*

The first part of this argument is grounded on the outcome from the exploration of literature from the empirical review and the conceptual framework. According to Kafayat (2014), project managers' personality traits have a huge impact on the overall performance of mega projects. In this regard, traits are considered as part of demographic characteristics, as they determine the managers' attitude and behaviours. In this case, the argument is supported by the rational choice theory in which case an association between how decisions are made and traits of an individual is found to exist. . Crawford (2011), also agrees with this theoretical position by arguing that a person's response to a particular situation is influenced by the general perception of their society towards the same situation, which is primarily the power of the human mind. The implication in this case is that since the people working on a particular mega projects at a given time are likely to view different situations differently owing to the fact that they come from different social backgrounds. A study by Diehl (2014) demonstrates that different demographic factors such as education, age and gender play an important role in the decision making process. The findings thus present gender as one of the important demographic factors that can have an impact on decision making during project planning and project implementation.

The level of knowledge by different individuals is yet another factor that has been associated with bias in decision making. In this study, the level of professional training in a particular field is used to represent knowledge. Equally, reviewed sources such as Sharon (2012) and Thomas (2013) indicate that project managers' motivation can be influenced by their demographic factors, which have the impact of influencing motivation or negatively, hence over-optimism or under-optimism respectively. Further, based on the fact that mega projects are complex, project managers' experience and ability to make appropriate decisions is important as it can potentially prevent cost overrun due to any king of optimism. Further on demographic characteristics, Vahidi (2013) makes an assumption that a very experienced project manager is able to evaluate the specific requirements of projects from planning to implementation stages, increasing the chances of project success and avoiding situations where projects fail due to cost overruns. Flyvbjerg et al (2003), Lee (2008), and Cantarelli et al. (2012b) present examples of mega projects exceeding their projected costs in the US, Korea, and the Netherlands respectively. While the experience of the participants in the projects is not explicitly stated, it is safe to assume that all professionals in these projects were adequately knowledgeable and experienced owing to the magnitude of the respective projects. This goes ahead to reveal that the effective planning and implementation of a mega project is dependent on more than mere experience of the different stakeholders.

*Determinants of cognitive biases in mega projects*

As reviewed from literature and conceptual framework, cognitive biases are actions in decision making based on perceived information and have been noted to disrupt and distort objective contemplation of an issue by introducing different influential factors in the decision making process that are mostly not related to the problem itself. In this study, twelve personal traits were evaluated.

The first cognitive bias considered in this study is controllability bias popularly known as illusion of control. Erol et al. (2018) noted that illusion of control bias has led to many mega projects to be approved based on over optimism of project managers but after approval the project managers realize their control is limited due to the diverse complexities surrounding the mega projects.. Moreover, Wang et al. (2019) maintain that controllability brings forth complexities in mega projects which have a huge impact in inhibiting prediction of outcomes, hence contributing towards project risks. Similar assertions have been supported by the theoretical underpins of contingency theory. As a result, project managers should use their knowledge in ensuring that they minimise project risks by authenticating project cost's practicality, especially by avoiding under-costing which is a major problem,

The second cognitive bias is availability as postulated by Kahneman et al. (1982) in their assertion that this has the ability to influence decision makers by making them to have a prejudgment on how easy or difficult a project seems to be. More importantly, Montibeller and Winterfeldt (2015) argue that this is usually affected by memory, in which project managers tend to remember similar projects they have handled in the past, and assume that it will conform to the same circumstances, not appreciating the dynamics that are present in the field of project management. Therefore, it is possible that this way of reasoning can lead to project failure because managers will be caught up surprises when they experience the real circumstances as opposed to what they hypothesises based on past experiences.

Montibeller and Winterfeldt (2015) further introduced another form of cognitive bias which is anchoring, in which case decision makers tend to concentrate on certain information, knowledge or experience during decision making process. Ideally, what this implies is that they end up repeating similar actions they must have made in the past, oblivious of the trends in the field of project management, particularly when making reference to mega projects. As a result, this leads to decisions which are limited to certain criteria without the ability to embrace new information that could otherwise be of crucial importance in project success.

The next cognitive bias considered is confirmation bias which occurs when the decision makers apply possible evidence related to previously held beliefs and critically examine or be doubtful to look at other possible evidence that might alter their view thus disregarding evaluating other possible evidences (Chatzipanos & Giotis, 2014). Confirmation bias also limits the information used in decision making indicating the decision makers apply a narrow view to the situation hence may have a huge impact on project cost overrun due to over optimism.

The fifth cognitive bias analysed is cognitive dissonance described as a psychological uncomfortable feeling that arise as a result of differing notions between new information acquired and the preceding view which causes cognitive illogicality due to the disparity in information (Ady, 2018). Moreover, Meshack (2016) puts emphasis on cognitive dissonance and states that it might be difficult to easily establish or identify or even monitor, hence can lead to improper decision making due to the inability to know in good time that it exists.

Dread bias is another cognitive bias checked in this study which relates to the loss version bias. The bias is emotional and occurs when individuals avoid adventures that may lead to losses by being risk averse as the suffering triggered by losses greatly exceeds the enjoyment of gains (Ady, 2018). In mega projects, decision makers become conservative and thus lose out on better opportunities to enhance the project's performance.

The seventh cognitive bias in this case is familiarity. Familiarity bias is presented by Boussabaine (2014) to be the amoutn of inforation project managers have. In situation where they deem they have more information, thet get over confidenct of success, while when they have little information they get nervous. However, such tyoe of familiary posses a danderous situation as perceptions of amount information cacot be used to determine whether the project will fail or succeed.

Then hindsight bias was examined as the eighth cognitive bias under scrutiny in this research and is defined as the tendency of leaning towards personal beliefs and assumptions which are overrating with regard to a certain phenomenon without being in possession of facts/ this is often multidimensional as the individuals have the ability to abandon or embrace it, depending on the rate at which they receive facts.

The ninth cognitive bias checked in this research is scale bias which is described as a kind of cognitive bias induced by having dissimilar methods of displaying and measuring a characteristic that includes the characteristic's classification of the upper and lower boundaries leading to an incompatible measurement between motivation and reaction Montibeller and von Winterfeldt (2015) explained several cognitive biases in this group such as logarithmic response, range equalizing bias, centering bias, contraction bias, and equal frequency bias but this study will focus on contraction bias that involves underrating large variances and overrating small variances.

Representativeness bias is the tenth cognitive bias analysed in this study that involves the manner in which one variable signifies another, for instance if variable A is considered to be highly representative of variable B then the possibility that variable B is influenced by variable A is confirmed to be high and vice versa, subsequently causing illusion of validity since the assurance of the likelihood relies on the extent of representativeness between the two variables (Kahneman et al., 1982).

Optimism bias was the eleventh cognitive bias checked in this research and exists when decision making is made on the basis of a desired result thus heightening the degree in which the desired result is anticipated to happen (Montibeller & von Winterfeldt, 2015). In this regard, it is often considered to be a wishful aspect since it is founded on the expectations project managers have, and it can have a huge impact particularly for mega projects which need estimates that are realistic as opposed to what one can wish.

Lastly, venturesomeness bias was checked and relates to making uncommon and risky decisions so as to explore new dimensions of outcomes regarding a particular subject matter. The bias is usually induced by a low level of conscientiousness that motivates decision makers to consider new ways of influencing the constraints experienced without incorporating the impact of the new method adopted. This bias increases the risk of cost overruns in mega projects due to being optimistic of the new notion included in decision making.

*Determinants of cost decision making in mega projects*

The cost decision making factors were primarily obtained by linking two theories which are descriptive decision theory and prospect theory to the big five model that elaborates personal traits which influence cognitive biases. The big five model encompasses of extraversion, agreeableness, conscientiousness, emotional stability, and openness to experience. Here, in-depth analysis to identify the constructs that represent cost decision making was undertaken from various previous literature. The details of how each of the construct was developed are discussed in chapter 3 of this thesis. The study opted to use 16 constructs from the exploration of literature which were noted to be sufficient in conducting this investigation

*Determinants of risk decision making in mega projects*

The risk decision making factors were primarily obtained by linking various literatures as described in chapter 3 of this research. Firstly, there is an integration between risk and decision making, followed by the factors affecting risk perception , followed by scrutinizing the risk behaviour of project managers, then the relationship between personality and risk behaviour respectively. The details of how each of the factors under risk decision making was developed is discussed in chapter 3 of this thesis. The study narrowed down to apply 20 factors which were seen to be critical in risk decision making from the exploration of literature and were noted to be sufficient in conducting this investigation.

*Modelling causes of Cost Overruns due to over Optimism*

Statistical techniques have been widely used as fundamental methods of analysing data in project management to unearth the basis or sources of factors limiting project success and make available guiding principles that can be implemented in project execution to reduce the possibility of incompetence while managing projects (Nayab, 2011). In the literature review, Cantarelli et al. (2012b) and Park and Papadopoulou (2012) are presented as having successfully applied different statistical tests in the analysis of data on cost overruns in different projects. The principal notion behind using statistical approaches is that similar influence should generate the same outcome. For instance, the dynamics of project success or failure are general and go beyond the nature of the projects and project managers, thus if everything else is held constant, focusing on success factors should rationally bring about project success (Ika, 2009).

Normally, projects are labelled as complex and multifaceted as explained in chapter 2. For that reason, multivariate statistical methods are applied such as variance analysis and multiple linear regressions to elucidate the connection between the explanatory variables studied (Ika, 2009). Data analysis is mainly through an exploratory approach that observes new trends or probabilities and a confirmatory approach that confirms assumptions and institute controlling principles (Nayab, 2011). In this study, both exploratory and confirmatory statistical methodologies were used to reveal the relationship between the identified determinants of over optimism and cost overrun in mega projects since over optimism is the key factor leading to cost overrun in mega projects as described in the literature review section. The exploratory and confirmatory approaches employed are discussed below:

*Exploratory Approach*

The data collected was first inspected for errors and incongruities eliminated (Nayab, 2011), then, descriptive statistics were used to check for trends in the perception of project managers on the identified determinants of over optimism. The following clarifies the outcomes of the descriptive statistics.

*Respondent's perception on cost overrun due to over optimism.*

The results suggested that 5 factors (OV1 – OV5) were applied in this study to check the perceptions on cost overrun due to over optimism. The descriptive statistics indicated varied responses with no inclination to a particular proportion of effect indicating the influence of over optimism on cost overrun is complicated and further research may elaborate this relationship better. This complication is confirmed in the literature by Love (2012) and Flyvbjerg (2003), who present conflicting arguments on the specific influence over optimism has on cost overruns. However, the main difference between the studies presented in the literature such as Love (2012), Flyvbjerg (2003), Flyvbjerg et al (2016), Sarmento and Renneboog (2016), and Huo et al. (2018)

with this study is that they evaluate the extent of cost overruns without giving attention to the specific causes at the decision making stage. The data in this study will thus go beyond the mere identification of the extent of cost overruns by exploring the potential causes.

Using survey data and consolidating the various responses from the factors that checked cost overrun due to over optimism, the results show that 20% respondents noted that the effect of over optimism on cost overrun is less than 5%. Around 17% respondents stated it is at 10%, 32% of the respondents said it is 15%, 19% of them noted the effect is at 20%, and 12% indicated the effect is more than 20%. While there is no agreed level of a permissible project cost overrun in the context of the evaluated literature, the findings indicate that 61% of individuals working in mega projects hold the opinion that over optimism accounts for over 10% price overrun.

From the definition as presented in chapter 1 by Flyybjerg (2017), a mega project is a complex physical development undertaking that costs in excess of US $1 billion. Putting this figure in the context of the results, it emerges that majority of the respondents hold the opinion that over optimism results in cost overruns amounting to at least US $100 million. Looking at cost overruns in the context of absolute values thus reveals that over optimism has serious financial implications which are most probably over 10% of the overall estimated project cost. In confirmation of these research findings an evaluation of road projects in Hong Kong by Flyvbjerg et al (2016) reveals that the average cost overrun is 11%. Sarmento and Renneboog (2016), in a similar research study also find cost overruns in mega projects in Portugal averaging 20%. All the literature presented on the financial implications of cost overruns reveals that most lead to over 11% increments in projected prices. Findings in the literature are therefore highly consistent with the findings presented on the impact of cost overruns in this research.

Table 5.1: Descriptive statistics findings for perceptions on determinants of over optimism

| **1 – Perceptions on determinants of over optimism** | |
|---|---|
| Research Question 2 | • What are the key project manager demographic characteristics that impact mega project decision making and performance? |
| Results | • 3 main factors were identified to contribute to over optimism that leads to cost overrun in mega projects that included cognitive biases (controllability, availability, anchoring, confirmation, cognitive dissonance, dread, familiarity, hindsight, scale, representativeness, optimism, and venturesomeness), cost decision making factors represented by 16 factors, and risk decision making factors represented by 20 factors.<br>• The results indicated all these factors have an influence on over optimism where the decision making factors and risk factors were seen to influence mega projects cost, whereas the cognitive biases were noted to influence cost decision making in mega projects except for 1 factor (cognitive dissonance) which showed respondents were indifferent in their perception towards its influence on cost decision making in mega projects. |
| Researcher's Observation | All the determinants of over optimism were noted to influence decision making that leads to cost overrun except for the cognitive dissonance bias. |

| | |
|---|---|
| | In mega projects, international standard procedures, processes and expertise are required hence the influence of cognitive dissonance bias was not observed to be important in decision making since no new information could be provided to cause psychological discomfort among the project managers. |
| Conclusion | All factors identified as determinants of over optimism are relevant in influencing decision making in mega projects that could lead to cost overrun. |

*Respondent's perception on cost overrun due to over optimism*

Using survey data and consolidating the various responses among the factors that checked cost overrun due to over optimism, the results show that 20% respondents noted that the effect of over optimism on cost overrun is less than 5%, 17% respondents stated it is at 10%, 32% said it is 15%, 19% of them noted the effect is at 20%, and 12% indicated the effect is more than 20%. The outcome show no inclination towards any proportion of effect signalling a deviation in the perception of respondents on this factor that could have resulted from the complexity in mega projects making it challenging to provide a similar range especially with the diverse rates of costs overrun in many mega projects within the international arena as explained in the review of literature section.

Table 5.2: Descriptive statistics findings for perceptions on cost overrun in mega projects

| 2 – Perceptions on Cost overrun in Mega Projects | |
|---|---|
| Research Question 2 | "What are the key project manager demographic characteristics that impact mega project decision making and performance? |
| Research Objective 1 | ascertain whether cognitive biases can be linked to causes of optimism and its impact in project decision making and performance. |
| Results | 5 factors (OV1 – OV5) were applied in this study to check the perceptions on cost overrun due to over optimism and the descriptive statistics indicated varied responses with no inclination to a particular proportion of effect indicating the influence of over optimism on cost overrun is complicated and further research may elaborate this relationship better. |
| Researcher's Observation | Over optimism was noted to cause cost overrun though the respondents showed diverse views regarding the effect of overoptimistic forecasts on project cost overrun.<br>• 20% respondents noted that the effect is less than 5%.<br>• 17% respondents stated it is at 10%.<br>• 32% said it is 15%.<br>• 19% of them noted the effect is at 20%.<br>• 12% indicated the effect is more than 20%.<br>The difference in perception for the effect of over optimism on cost overrun in mega projects may be attributed to the view of complexity in mega projects and wide difference in amount of cost overrun observed on various mega projects. |

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| Conclusion | Over optimism influences cost overrun in mega projects though the extent of effect varies since there was significant difference in the perception of the effect of over optimism on cost overrun in mega projects. |

*Confirmatory Approach*

In order to reach various objectives of this research, the study applied three statistical techniques that are variance analysis also known as analysis of variance or ANOVA, Correlation and regression method. Analysis of variance is a statistical test for spotting differences in clustered data and encompasses one dependent variable and one or more independent variablesANOVA identifies the degree of nonconformity from the standard mean (Nayab, 2011) and determines the reason of the variance (Cross, 2019) thus serving as a useful tool in variance analysis. When exploring project management practices, variance analysis assists to manage a project's costs. Operational variance analysis can aid companies to discover trends, problems, prospects and inhibiting factors to current and enduring success (Cross, 2019). However, in the case of this thesis, the variance analysis is concerned with evaluating the is difference from the mean in rating research questions.

Regression analysis has led in many studies that look at the diverse factors influencing project success because it not only analyses data using statistical measures but it provides a way to understand social elements (Ika, 2009). Mostly, company research uses regression methods to evaluate the effects of stimuli on people during decision-making. The approach evaluates the association between two or more variables (Crawford, 2006) and provides a quantitative estimate of the impact of one variable on another or other variables (Nayab, 2011). Further, in a relationship between variables, regression analysis looks at which elements are important and which can be neglected with the most important consideration being the extent to which the variables influence each other.

Before conducting the ANOVA analysis and regression analysis, the data was checked for the assumptions underlying both tests. Normality check was analysed using skewness and kurtosis, linearity was checked using normality P - P plots, multi-collinearity was examined using Pearson's correlation coefficient between independent variables, tolerance and variance inflation factor (VIF) values, and scatter plots check for homo-scedasticity. Again, Pearson's correlation coefficient was incorporated to check for association between dependent and independent variables. Finally, hierarchical regression model was developed to confirm the most influential factors that have an upshot on cost overrun due to over optimism.

*Variance Analysis*

*Respondent's demographic attributes on cost overrun factors*

Table 5.3 below summarizes the ANOVA results that looked at the differences in perception of project managers on cost decision making factors

Using the survey analysis in Chapter four of the thesis, no statistically significant difference was found in perception regarding the proportion of cost overrun due to over optimism based on the demographic attributes. This finding indicates that the demographic attributes analysed do not influence the view of the extent in cost overrun due to over optimism. Comparing this finding to the literature it is found that the results are in contradiction to the argument presented b Garemo et al. (2015) who insists that project managers, in most cases apply their personal biases to come up with overly optimistic projections of project costs. The study by Garemo et al. (2015), however, does not directly discuss the role of the demographic attributes evaluated in this research meaning that this could be the reason for the contradiction of the findings.

The results suggested that five factors represented by OV1 – OV5 checked cost overrun due to over optimism. The ANOVA results showed that there is no statistically significant difference between the respondents' perceptions on ‘the effect of over optimism on cost overrun’ except for OV2. The test has shown that there are significant differences in the way respondents perceived OV2: Egocentric interpretation of project scope. CEOs perceived the egocentric interpretation of project scope increases the impact of over optimism on cost overrun. Engineers on the other hand perceived that egocentric interpretation of project scope reduces the impact of over optimism on cost overrun. This difference in perceptions between CEOs and engineers could be attributed to the fact that CEO’s manage the overall features of the project such as costs that might lead to excessive funding. For engineers however, egocentrism revolves around displaying extra knowledge, skills and expertise, which is perceived to lead to reduction in the amount of cost overrun (Ramos, 2019). In conclusion, it could be argued that the null hypothesis ($p < 0.05$) was rejected for factor: OV2 while the null hypotheses ($p < 0.05$) were accepted for the other factors representing cost overrun due to over optimism.

Table 5.3: ANOVA analysis summary for cost decision making factors in mega projects

| **3 – Demographic attributes and cost decision making factors in mega projects** | |
|---|---|
| Research Question 3 | • What are the personality traits of project managers that can be associated with cognitive bias, decision making and performance? |
| Research Objective 1 | Ascertain whether cognitive biases can be linked to causes of optimism and its impact in project decision making and performance. |

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| Hypothesis | $H_0 1$: There is no statistically significant difference between the respondents' perceptions on ***'cost decision making in mega projects based on job position, experience and culture'***.<br>$H_A 1$: There is statistically significant difference between the respondents' perceptions on ***'cost decision making in mega projects based on job position, experience and culture'***. |
| Results | Considering that 15 factors out of the 16 factors (DM1 – DM16, DM4 removed due to reliability) were recognised in this study to gauge cost decision making, the ANOVA results signalled that there were no significant differences between the respondents' perceptions on 'cost decision making in mega projects based on job position, experience and culture except for the following factors:<br>*Job position* **(DM6 and DM10),** *Experience* **(DM1)** and *Culture* **(DM6)**. |
| Researcher's Observation | From literature review, the cost decision making factors relating to mega projects have been linked to knowledge, experience, and culture where in this study, knowledge is represented by job position.<br>There is a strong view about the cost decision making factors among engineers, project managers, CEO's, directors and others since their perceptions heavily tended towards incorporating the various cost decision making criteria checked in this study.<br>There was no difference in perception of all the other cost decision making criteria based on job position, experience and culture except for the following.<br>• The view of basing decisions on the reality of the projected project performance (DM6) varied significantly between directors and others where directors adopted this criteria in decision making whereas others tended to be neutral regarding this criteria which could be attributed to the lack of information surrounding projections of project's performance by the others category.<br>• The criteria of incorporating accountability and consequences during cost decision making (DM10) varied significantly between engineers and CEO's, directors and others as engineers have to be |

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| | accountable by following predetermined procedures to ensure the project meets the minimum required standards such as safety and viability of project and hence have no much concern about the costs as long as the project's standards are not compromised whereas CEO's, directors and others focus on managing the costs thus this factor is of great concern to this team.<br>• The issue of using bottom-up decision-making techniques so as to include all what is known about a problem varied significantly between those with 3- 5 years' experience and those with 20 and above years' experience. Bottom up decision making was not considered important by those with 3 – 5 years' experience as perceived by those with 20 and above years' experience. |
| Conclusion | The null hypothesis $H_0 1$ ($p < 0.05$) was rejected for factors: DM1, DM6, and DM10 while the null hypotheses $H_0 1$ ($p < 0.05$) were retained for the other cost decision making criteria |

*Respondent's demographic attributes on risk decision making*

Using the survey analysis in Chapter 4 of this thesis, the outcome showed that there is no statistical significant difference in perception of risk decision making factors based on the demographic elements that are job position, experience and culture signalling that the demographic attributes analysed do not influence the method in which project managers make risk decisions.

Table 5.4 below summarizes the ANOVA results that looked at the differences in perception of project managers on risk decision making factors. The table shows that the null hypothesis was accepted specifying no statistical difference except in five risk decision making factors: R2, R9, R17, R18, and R19. The test has shown that there are significant differences in the way respondents perceived R2: Visibility and downstream consequences, R9: Resource availability, R17: Problems ambiguity, R18: External dependencies, and R19: Largeness and uncertainty of scope.

The survey indicated that risk decision making is important in managing mega projects. Engineers supported being visible and considering downstream consequences during risk decision making as their visibility ensures compliance to standards set and downstream consequences are vital since any engineering fault could cause a disaster and further lead to revocation of engineering license or inability to secure future projects due to failure in current project. For others category, this view was not perceived as important since it has minimal impact on the performance of projects and also, may not have detrimental consequences to the others category. Moreover, engineers found resources availability to be an imperative element in risk decision making as it determines the timely execution of tasks. One of the major bottlenecks in mega projects is the timely delivery of resources as noted in literature review section in that delay in availability of resources, delays the execution of tasks and hence delays the project as a whole leading to poor project performance, cost overruns and related consequences. The others category are not much concerned about the availability of resources as they may not directly see the negative effects surrounding this issue. Another issue was problem ambiguity where CEO's found this factor as not important while directors and others perceived it to be important. Due to the complexity in mega projects, the problems are also varied and directors and others perceive this as a risk but CEOs see this issue as not important since as a leader, problems are common and can easily be resolved through cooperation and team work. In addition, CEO's perceived external dependencies as unimportant attributed to the nature of mega projects where external influence from governments or other stakeholders determines the success of the mega project hence if CEO's abide by the external forces who are usually the owners of the mega project, then the project performance becomes irrelevant and the CEO is rated on his/her compliance to the funding team. Other category perceive external dependencies as important since the external forces determine the project success rate. CEO's did not perceive largeness and uncertainty in scope as important element in risk decision making since resources to manage this issue have been analysed and confirmed before project execution in addition to the satisfactory experience in handling similar projects but others category viewed this issue as important since the issue increases the complexity in projects.

Table 5.4: ANOVA analysis summary for risk decision making factors in mega projects

| **4 – Demographic attributes and risk decision making in mega projects** | |
|---|---|
| Research Question 3 | What are the personality traits of project managers that can be associated with cognitive biases, decision making and performance? |
| Research Objective 2 | Determine whether cognitive biases can be linked to project manager demographic characteristics and its impact on project decision making and performance. |
| Hypothesis | $H_0$2: There is no statistically significant difference between the respondents' perceptions on ***'project risk factors in mega projects based on job holder, experience and culture'***.<br><br>$H_A$2: There is statistically significant difference between the respondents' perceptions on ***'project risk factors in mega projects based on job holder, experience and culture'***. |
| Results | 20 factors (R1 – R20) were identified in this study to examine the perceptions on risk decision making and the ANOVA results signalled that there were no significant differences between the respondents' perceptions |

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| | on ‘‘project risk factors in mega projects based on job position, experience and culture except for the following factors:<br><br>*Job position* **(R2, R9, R17, R18, and R19)** |
| Researcher’s Observation | The literature review linked the various project risk factors used in mega projects decision making to knowledge, experience, and culture where in this study, knowledge is represented by job position.<br><br>• The study shows many of the project risk factors were incorporated in decision making by engineers, project managers, CEO’s, directors and others as their perceptions were inclined towards including the various project risk factors evaluated in this research.<br>• There was no difference in perception of all the other project risk factors based on job position, experience and culture except for the following.<br>• The perception of including visibility and downstream consequences (R2) varied significantly between engineers and others as this factor relates to a high extent for engineers but to a limited extent for others. Engineers have to be visible to ensure compliance to standards set and also consider downstream consequences as it may lead to revocation of engineering license or inability to secure future projects due to failure in current project.<br>• The perception of considering resource availability (R9) when making decisions relating to risk also varied significantly between engineers and others attributed to the view that engineers need resources to progress the execution of the project while the others category assume resources are available and is least concerned about its availability.<br>• The issue of including problems ambiguity (R17) during risk decision making varied significantly between CEO and directors and also between CEO and others which could be necessitated by the view that CEO’s consider this as not a risky factor as it can easily be resolved through cooperation and team work while |

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| | directors and others saw this issue as important since mega projects are complex and they are fully involved in resolving any problem.<br>• The project risk factor, external dependencies (R18), showed significant difference in perception between CEO's and others where CEO's viewed this factor as unimportant while others category perceived it to be important during project risk decision making.<br>• The issue surrounding largeness and uncertainty of scope was not an important issue for CEO's but important for others category causing significant variance in decision making regarding this issue. CEO's do not consider the size and complexity of mega projects during risk decision making which could be as a result of resources allocated and experience in managing similar projects. |
| Conclusion | The null hypothesis $H_02$ ($p < 0.05$) was rejected for factors: R2, R9, R17, R18, and R19 while the null hypotheses $H_02$ ($p < 0.05$) were accepted for the other project risk factors used in mega projects decision making. |

*Discussion of respondent rating of cognitive biases*

Using the survey analysis in Chapter 4 of this thesis, the outcome showed that there is no statistical significant difference in perception of personal traits that influence cost decision making based on the demographic attributes signalling that the demographic attributes analysed do not sway the personal traits that influence cost decision making. The following explain the results.

Four types of cognitive biases (controllability bias, dread bias, familiarity bias, optimism bias) indicated that there were no significant differences between the respondents' perceptions on the sway of these factors on cost decisions in mega projects based on job holder, experience and culture.

For the other factors (availability bias, anchoring bias, confirmation bias, cognitive dissonance bias, and venturesomeness bias) there were no significant differences between the respondents' perceptions on the sway of these factors on cost decisions in mega projects based on job holder, experience and culture except for the following factors: Availability (A1, A2), anchoring (An1, An5), confirmation (CN1, CN2), cognitive dissonance (CD2, CD3), and venturesomeness (V3).

Table 5.5 below summarizes the ANOVA results and shows that the null hypothesis was accepted specifying no statistical difference except in nine factors: The test has shown that there are significant differences in the way respondents perceived A1: I usually take cost decisions by considering the old experiences, A2: The cost mistakes I made in the past allow me to take important decisions, An1: I make adjustments in the things that could contribute to the cost risk, An5: Estimations are made from the initial value and then assessed to arrive at the final cost, CN1: I need confirmation about different cost decisions that I take, CN2: When making cost estimation decisions I need to get the confirmation from the different evidences, CD2: I usually get confused between my cost decisions and beliefs, CD3: I usually change my decisions according to my beliefs, and V3: I am ready and willing to take different costing decisions.

The survey indicated that personal traits influence cost decision making. Demographic attributes that showed statistical difference in perception are explained below.

Engineers agreed to use cost mistakes made in the past in allowing them to make important decisions (A2) but project managers, directors and others disagreed leading to differences in perceptions regarding this question indicating engineers somehow exhibit the availability biasness.

More, respondents with between 11 – 19 years agreed to make cost decisions by considering the old experiences (A1) whereas those with 6 – 10 years disagreed signalling those with much experience, appreciate and use the experiences in making cost decisions and thus display availability biasness.

Others respondents agreed to make adjustments in areas that could contribute to cost risk (An1) while engineers disagreed to doing so. Even though the actual cost might overrun, engineers are not willing to compromise their work with the intention of reducing cost since it may have significant impact in both the safety and minimum standards required on specific works.

Moreover, other respondents agreed to make estimations based on an initial value and then assessed to arrive at the final cost (An5) while engineers disagreed indicating engineers did not display the anchoring biasness whereas others displayed.

Further, engineers showed they did not need confirmation on the different cost decisions they take, but others demonstrated otherwise implying lack of confirmation biasness among engineers but showed by the others category which could be attributed to the knowledge and experience engineers possess hence they do not see the need to confirm their decision making.

Project managers tended to agree that they needed confirmation from various evidences to make cost estimation decisions but engineers differed with them in this view which is attributed by the reason that project managers handle diverse tasks necessitating the need to seek confirmation while engineers are specialised in one particular area and hence do not need confirmation from any other source.

Respondents with 0 – 2 years agreed to frequently get confused between their cost decisions and beliefs while those between 11 – 19 years differed. Those with less than 2 years' experience are individual who are inexperienced and thus the confusion is expected as opposed to those with 11 – 19 years' experience who are considered mature in the industry.

Due to lack of experience, respondents with 0 – 2 years agreed to usually change their decisions according to their beliefs while those with 11 – 19 years disagreed indicating they are more fact oriented as opposed to apply their beliefs.

Respondents with 3 – 5 years agreed to being ready and willing to take different costing decisions while those with more than 6 years differed indicating the more the experience, the less venturesomeness is portrayed which could be attributed to experiences of losing due to trying new techniques.

Table 5.5: ANOVA analysis summary for personality traits related to project cost decision making in mega projects.

| **5- Personality Traits Related to Project Cost Decision Making** | |
|---|---|
| Research Question 3 | What are the personality traits of project managers that can be associated with cognitive biases, project decision making and performance? |

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| Research Objective 3 | Investigate the personality traits of project managers that can be associated with cognitive biases and how this impact project decision making and performance. |
| Hypothesis | $H_0$3: There is no statistically significant difference between the respondents' perceptions on ***'personality traits that influence project cost decisions based on job holder, experience and culture'***.<br><br>$H_A$3: There is statistically significant difference between the respondents' perceptions on ***'personality traits that influence project cost decisions based on job holder, experience and culture'***. |
| Results | 9 out of 12 factors (3 deleted due to reliability; hindsight, scale & representativeness) were identified in this study to examine the cognitive biases that influence decision making. The 9 factors were represented by 31 constructs in which the ANOVA results showed that there is no statistically significant difference between the respondents' perceptions on 'personality traits that influence project cost decisions based on job holder, experience and culture' except for the following constructs.<br><br>Availability (A1, A2), anchoring (An1, An5), confirmation (CN1, CN2), cognitive dissonance (CD2, CD3), and venturesomeness (V3). |
| Researcher's Observation | The main finding from the survey was that there was no statistically significant difference between the respondents' perceptions on 'personality traits that influence project cost decisions based on job holder, experience and culture' – except for the cases below that summarize the linkage between various biases and demographic attributes.<br><br>• Engineers and those with between 11 – 19 years portrayed availability biasness,<br>• Engineers also showed anchoring biasness. |

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| | • Project managers and others displayed confirmation biasness.<br>• Respondents with 0 – 2 years displayed cognitive dissonance biasness.<br>• Respondents with 3 – 5 years showed venturesomeness biasness. |
| Conclusion | The null hypothesis $H_0 3$ ($p < 0.05$) was rejected for factors: A1, A2, An1, An5, CN1, CN2, CD2, CD3, and V3 while the null hypotheses $H_0 3$ ($p < 0.05$) were accepted for the other personal traits that influence cognitive biases in mega projects decision making. |
| | |

*Discussion of Respondent's rating of cost overrun factors*

Using the survey analysis in Chapter 4 of this thesis, it was found that there is no statistical significant difference in perception regarding the proportion of cost overrun due to over optimism based on the demographic attributes indicating that the demographic attributes analysed do not influence the view of the extent in cost overrun due to over optimism.

Table 5.6 below summarizes the ANOVA results and shows that the null hypothesis was accepted specifying no statistical difference except in one cost overrun factor: OV2. The test has shown that there are significant differences in the way respondents perceived OV2: Egocentric interpretation of project scope. CEOs perceived the egocentric interpretation of project scope increases the impact of over optimism on cost overrun whereas engineers perceived it reduces and could be attributed to the fact that CEO's manage the overall features of the project such as costs and egocentrism might led to excessive funding whereas foe engineers, egocentrism revolves around displaying extra knowledge, skills and expertise which is perceived to lead to reduction in the amount of cost overrun.

Table 5.6: ANOVA analysis summary for cost overrun due to over optimism

| **6 – Demographic attributes and cost overrun due to over optimism** | |
|---|---|
| Research Objective 4 | Propose recommendations that can be adopted by project managers when executing mega projects. |
| Hypothesis | $H_0$4: There is no statistically significant difference between the respondents' perceptions on '***the effect of over optimism on cost overrun'***.<br><br>$H_A$3: There is statistically significant difference between the respondents' perceptions on ***'the effect of over optimism on cost overrun'***. |
| Results | 5 factors represented by OV1 – OV5 checked cost overrun due to over optimism. The ANOVA results showed that there is no statistically significant difference between the respondents' perceptions on 'the effect of over optimism on cost overrun' except for **OV2.** |
| Researcher's Observation | The main finding from the survey was that there was no statistically significant difference between the respondents' perceptions on 'the effect of over optimism on cost overrun' based on job holder, experience and culture' – except for one cases below.<br><br>• CEOs perceived the egocentric interpretation of project scope increases the impact of over optimism on cost overrun whereas engineers perceived it reduces which is caused by the difference in job roles between CEO and engineers. |

| | |
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| Conclusion | The null hypothesis $H_04$ ($p < 0.05$) was rejected for factor: OV2 while the null hypotheses $H_04$ ($p < 0.05$) were accepted for the other factors representing cost overrun due to over optimism. |

*7.3.2 Association Analysis*

The study applied linear regression model to analyse the relationship among the cognitive biases, cost decision-making, risk decision-making, and cost overrun due to over optimism. In addition, the relationship between demographic attributes and over optimism was analysed.

The summary of the various relationships have been provided.

The regression analysis shows that there is no significant statistical relationship between cognitive biases and over optimism. This finding leads to the acceptance of the null hypothesis. The results indicated none of the nine cognitive biases checked showed statistical significance in having an impact on over optimism. The other cognitive biases that included availability, anchoring, confirmation, cognitive dissonance, familiarity, optimism, and venturesomeness indicated no statistical significance thus contradicting theoretical arguments presented in the literature. Mentis (2015), for example, in his discussion of controllability reveals that the perceptions of the ease of controlling the outcomes of a megaproject has the potential to account for factors that might not be obvious at the planning stage thus leading to cost overruns. This argument is supported by Marsh (1998) and Blettner (2010). However, Marsh (1998) goes ahead to appreciate the fact that there are many other factors that are likely impact a project's outcomes hence the relationship between various elements of cognitive bias and project cost overrun is much more complex.  This appreciation of the complexity of the relationship is an indication that the finding of no statistically significant relationship between cognitive bias and cost decision making is plausible.

On the other hand, cost decision making was found to be statistically significant in influencing cost overrun due to over optimism while risk decision making was found not to be statistically significant in influencing cost overrun due to over optimism. The study thus indicates that project cost overrun as a result of over optimism is not significantly affected by risk decision making but is affected by cost decision-making. One plausible reason why this might be the case is risk management in mega projects is handled collectively as a team and hence any risk related to cost are jointly decided making it hard to be over optimistic. For costs decisions, however, Bracha and Brown (2010) in the literature review argue that highly optimistic CEOs and project managers are more likely to make sub-optimal cost decisions thus ultimately leading to cost overruns. In addition to Bracha and Brown (2010) agree with the presented research findingsthat results on the relationship between optimism and cost decisions are varied meaning that the specific effect of cost decision making on cost overrun resulting from over optimism needs to be investigated further. In the context of this research, however, the concurrence between the findings and arguments based on theory is an indication that cost decision making is a more important determinant of cost overruns than risk decision making.

Availability bias, anchoring bias, dread bias, and familiarity bias were found not to be statistically significant in affecting over optimism in cost decision making. In concurrence with these findings in the context of availability bias Moradi et al. (2013), in the literature review, point out that many individuals in the financial sector have been found to make decisions based on how well they can recall a similar situation. In this regard, people who associate certain decisions with success are more likely to make the decisions in future than those who have had negative outcomes in the past. The former can thus be said to be more optimistic than the latter. Love (2016), Rabin (2011), and Boussabaine (2014) also indicate the impact of anchoring bias, dread bias, and familiarity bias on the optimism in cost decision making. The findings of this research are in concurrence with the findings and arguments presented in the literature in the context of the impact of different forms of personality traits on cost decisions. However, the findings reveal that controllability bias, confirmation bias, cognitive dissonance bias, optimism bias, and venturesomeness are not statistically significant. Hetemia et al. (2017), in their evaluation of controllability reveal that, in the general context, people are likely to make decisions depending on how well they think they can predict the outcome of a given situation. More specifically, in the context of mega projects, Marsh (1998) and Carr and Blettner (2010) reveal that controllability bias has been observed in multiple cases to lead to negative project outcomes. From the arguments by the authors it can be inferred that they are making a claim of a significant association between controllability bias and project cost decisions. However, none of the sources make an explicit mention of cost decisions and so the literature neither confirms nor disputes the presented finding. In similar fashion to Marsh (1998) and Carr and Blettner (2010), Groopman (2010) and James Konow (2000), with regard to confirmation bias and cognitive dissonance respectively, do not explicitly state the relationship with cost decisions in mega projects. The lack of sufficient evidence to confirm or dispute the results in the above mentioned contexts is an indication that more research is necessary in this direction to address these gaps.

In conclusion, it could be argued that the null hypothesis ($p < 0.05$) was rejected for all other cognitive biases while the null hypotheses ($p < 0.05$) were accepted for dread factor and for controllability at $p < 0.10$.

*Decision-making and cost overrun due to over optimism*

Cost decision making was represented by 15 factors (DM1 – DM16, DM4 deleted). The regression results showed that cost decision making is positively related to over optimism at 0.10 significance, influencing three (2.7) %. Risk decision making was represented by 20 factors (R1 – R20). The regression results showed that risk decision making is not related to over optimism. According to Researcher's observation, the main finding from the survey was that there is statistically significant relationship between cost decision making and 'the effect of over optimism.

With regard to risk, the study thus indicates that risk decision making in mega projects is linked to other factors and not cost overrun due to over optimism which could be due to the fact that risk management in mega projects is handled collectively as a team and hence any risk related to cost are jointly decided making it hard to be over optimistic. Conversely, any decision regarding cost should have an influence on cost overrun portraying the rationality of the finding.

In conclusion, the null hypothesis $H_05$ ($p < 0.05$) was accepted for cost decision making while the null hypotheses $H_05$ ($p < 0.05$) was rejected for risk decision making. In the same line, availability bias, anchoring bias, dread bias, and familiarity bias were found to be statistically significant in influencing cost decision making and controllability bias, confirmation bias, cognitive dissonance bias, optimism bias, and venturesomeness were found not to be statistically significant.

*Summary*

The specific focus of the first research question, was to investigate the impact of cognitive bias on the decision making process. Generally, the findings have shown that cognitive bias has no profound impact on decisions that lead to cost overruns in mega projects. However cognitive factors such as familiarity bias and dread bias were found to be negatively correlated to cost overruns in mega projects. The implication in this case is that high levels of dread bias and familiarity bias would result to poor decisions that would lead to cost overruns. On the contrary, a specific focus on cost decision making has been found to be positively related to decisions in mega projects. In this regard, decisions that are increasingly based on costs are likely to lead to a decline in cost overruns in mega projects

According to Researcher's observation, the main finding from the survey was that there is no statistically significant relationship between cognitive biases (controllability, availability, anchoring, confirmation, cognitive dissonance, dread, familiarity, optimism and venturesomeness) and 'cost decision making in mega projects'.

By incorporating the demographic variable that showed significance, the cognitive biases that were significant in influencing cost decision making hierarchical regression model was developed. The results indicated work experience, dread bias and cost decision making were statistically significant in influencing cost overrun due to over optimism. Even though literature has indicated that cognitive biases influenced cost and risk decision in mega projects, this study find empirical evidence that indicates only the dread bias has influence on over optimism. As well, availability bias, anchoring bias, dread bias, and familiarity bias were the only biases that impact on cost decision making.

# Chapter Eight: Conclusion

The chapter presents the conclusions drawn out of this research. Firstly, the robustness of the methodology applied is scrutinized, and then the objectives of the research are revisited with a view to compare the expected result with the achievement accomplished. Thirdly, the limitations of the research are provided, followed by the familiarization of contribution to knowledge and lastly, areas for further research are presented.

## *8.1 Robustness of the Methodology*

The research methodology adopted to realize the aim and objectives of this research was presented Chapter 3. Mixed model research approach entailing of qualitative and quantitative measures was employed to reach the objectives of this study. Qualitative involved carrying out an in-depth literature review to synthesise existing knowledge on the factors leading to cost overrun due to over optimism in mega projects so as to identify gaps in the research, then develop and refine the research questions and objectives. The exploration of literature resulted in the identification of numerous factors which were cross-referenced to document their validity. Further, the factors were classified and clustered according to the characteristics of influence. This produced a grouped list that was then developed into a questionnaire for collecting primary data. An online survey was used for this purpose. The questionnaire questions were tested on a small sample of academic students to make sure the questions are meaningful after which the questionnaire was presented to participants who were selected randomly from students pursuing courses related to project management. The questionnaires were completed anonymously. A statistically significant number of responses were received and then the data were checked for errors, completeness and consistency. Sample cases with significant missing information were not used in the analysis. Data were coded according to SPSS standards. Several statistical tools were deployed to analyse the collected data. For example, descriptive statistics were used to study the variation in the responses and observe trend whereas ANOVA and regression analysis was used to estimate the association between the factors influencing over optimism and the dependent variable.

Furthermore, an in-depth literature review was carried out to synthesise existing knowledge on the methods for modelling the relationships between the independent and dependent variables leading to the adoption of ANOVA analysis and multiple regression techniques to model the relationship between the factors of over optimism and their impact. The most important factors impacting on over optimism were selected based on the reliability and validity of the questionnaire analysis. These factors were then used to collect real-world data from a group of professionals specializing in project management. Several fitting measurements were used to assess the validity and robustness of the developed model. For example, in regression significance, normality tests, linearity test, multicollinearity, homoscedasticity, and correlation test were used to measure the accuracy of the derived model. The approaches taken in this study are considered to be suitable given the unique characteristics of the research framework developed in the course of this investigation.

### *8.2 Accomplishing the Research Objectives*

In order to keep the research focused on specific outcomes, three core research objectives were set. The first research objective focused on elaborating how cognitive biases influence decision making in mega projects. The second research objective sought to ascertain whether cognitive biases are linked to the increase in size and scope of mega projects, thus, leading to cost overrun. The third and final research objective focused on identifying innate characteristics of mega projects that influence decision-making. The purpose of the research was thus to bring in light the effect of cognitive biases on daily decision making that stakeholders in mega projects might not be aware of during the project implementation stage. Moreover, the study purposed to stimulate interest in scholars to carry out more investigation on the impact of cognitive bias on decision making in different contexts.

A combination of literature sources identified the determinants of over optimism that lead to cost overrun in mega projects. From the literature review, the main determinants of over optimism in mega projects were clustered into three groups. These are cognitive biases, cost decision making factors, and risk decision making factors. All these three categories are identified in the literature as some of the key decision making influences that determine the kind of decisions that are made by different stakeholders in during planning and implementation stages of mega projects. The determinants of over optimism were researched and explained in Chapter 2. Accomplishing this objective was necessary to follow through the subsequent research objectives. These factors of over optimism were used to develop a questionnaire to assess the perceptions of project managers regarding these factors and the likelihood of their occurrence in UAE mega projects. Additionally, the relationship between the factors of over optimism was examined.

The result of the research provided quite insightful and thought provoking information regarding the link between decision-making and cost overrun in mega projects. The result of the survey conducted from the participants enabled to categorize the result in two broad categories. The first category was the exact responses from the participants on closed ended question. The second category was the statistical analysis of their responses. The responses of the participants suggested that decision-making is an important element in mega projects costs. This result was obtained after majority of the participants gave their verdict in the favor of decision making on the overall cost of the project. In another response, the participants suggested that risk decision-making is an important element in mega projects costs. This result was obtained after majority of the participants gave their verdict in the favor of risk decision making on the overall cost of the project. Similarly, controllability was observed to be an important factor, which influences the decision making as more than 70% of the participants alluded to its profound role. Availability was also observed to be an important factor, which influences the decision making among most of the respondents. In addition anchoring, confirmation, familiarity, optimism, cognitive dissonance, and venturesomensess were also found to significantly impact the kind of decisions that were made in mega projects. On the contrary, dread bias, project scale, and representativeness showed mixed outcomes as while some respondents affirmed their importance, a significant number stated otherwise.

The second step in the evaluation of the result was the statistical analysis of the data obtained. The correlation analysis identified only two variables that had a significant relationship with other variables. Confirmation was significantly correlated with Job Position while Venturesome was significantly correlated with Job experience. The positive correlation between venturesomeness and job experience thus revealed that people with more experience are more likel to take on more risky and challenging roles compared to their less experienced counterparts. This is due to the fact that with the passage of time and with gaining of experience they have acquired skills and temperament that enable them to be much bolder in a wide range of situations.

The regression analysis was done in two phases. The first phase focused on conducting individual regression analysis of the variables. While the second phase focused on conducting a hierarchical regression. The first hypothesis created that Controllability cognitive bias is associated with over optimism and cost decision-making was rejected, as the variables were not statistically significant. The second hypothesis which posited that Availability cognitive bias is associated with over optimism and cost decision-making was rejected as well. The third hypothesis which claimed there being an association between anchoring cognitive bias and over optimism and cost decision-making was rejected for over-optimism as the variables were not statistically significant, however it was accepted for Cost decision-making, as the variables were statistically significant. The fourth hypothesis which alluded to the association between confirmation cognitive bias with over optimism and cost decision-making was also rejected, as the variables were not statistically significant. The fifth hypothesis on the association between cognitive dissonance with over optimism and cost decision-making was rejected as well. The sixth hypothesis which claimed that Dread cognitive bias is associated with over optimism and cost decision-making was rejected also rejected. The seventh hypothesis which posited that Familiarity cognitive bias is associated with over optimism and cost decision-making was rejected as well since the variables were not statistically significant. The eighth and ninth hypotheses were also rejected on the ground that the relationship between the respective variables was not statistically significant.

In summary, the regression analysis revealed that cognitive bias does not have a significant relationship with cost decision making and as a result with cost overrun. However, the responses of the participants suggest that they give importance to cognitive biases and their implication on cost decision making cannot be ignored. It is also important to highlight the fact that some of the sources evaluated in the literature review presented arguments that insisted on the significant relationship between cognitive bias and decision making. The disagreement between some of the findings of the regression in this research and previous research means that much more rigorous research studies are necessary in order to determine the actual relationship between different elements of cognitive bias and cost decision making in mega projects.

*8.3 Generalisability, Applicability and Implications of the Findings*

In this section, the generalisability of the research findings are discussed. The developed regression model are more suitable for investigating the impact of possible causes of over optimism at the bidding stages, during approval and execution of mega projects, and thus will allow for the development of contingency budgets. Further, the contracting parties will be able to optimise their bids and put in place mitigating strategies for dealing with the possible causes of over optimism. Since the source of the primary data was from UAE professionals in the project management, this research can be applied in other settings due to the commonalities across similar industries in different countries.  Definitely the modelling framework proposed in this research provides applicability opportunities for this research in the project management field across nations. In order to do so, essential adjustments or additions to the determinants of over optimism data and the associated possible cost overruns will be required to make certain it reflects the modelling context. Important to note from this research model is the possible appropriateness of the developed modelling framework to support decision making through the evaluation of over optimism and its impact. The use of statistical techniques will build more confidence in the decision making process for estimating the impact of cost overrun due to over optimism.

*8.4 Research Limitations*

While many efforts were made to ensure the research gave objective findings that are guided by specific objectives, a number of limitations were present. First, the identification of the determinants of cognitive bias was based on the literature and data related to mega projects. However, from chapter 1, it is evident that there is no clear definition of a mega project. For that reason, it is not possible to determine whether all the respondents involved in the study understood the term 'mega project' to mean the same thing. For the research to be more effective, the factors of over optimism should be gauged based on the size of mega project as it enhances homogeneity of data and lead to better generalization. The implication in that case, is that the researcher should provide the respondents with a working definition of a mega project so as to ensure all responses are based on a project of the same magnitude and scope.

Secondly, the research did not include all the factors determining cognitive bias, this research identified only a limited number of factors that the researcher thought would allow a sufficient investigation on the issue of cognitive bias. However, other factors such as education level and social status, which might have a profound impact on the kinds of decisions made by different individuals, were not considered. For that reason, it is impossible to tell whether or not a complete picture of the situation was obtained from the presented findings.

Thirdly, the research evaluated various determinants of cognitive biases based on closed ended questions on the survey instrument but the research did not provide leeway for the respondents to highlight other possible determinants of over optimism. This argument shows that the research has a methodological shortcoming in that the numerical data obtained did not provide any detail on each of the factors that data was being collected. For that reason, it is likely that the research missed some essential facts that would have had a significant impact on the findings and conclusions made.

In addressing the above mentioned shortcomings, future researchers investigating the impact of cognitive bias will need to, first of all determine the best definition of a mega project to work with in the data collection process. Secondly, a comprehensive list of all the important factors that need to be evaluated should be prepared beforehand so as to enable the collection of all-inclusive data. In addressing the methodological shortcoming, future research will need to consider applying a mixed methods approach that uses both questionnaires and interviews in the data collection process.

### *8.5 Contribution to Knowledge of the Research*

The research provides a clear conceptualisation of the factors that lead to cost overrun due to over optimism. The focus of this research was directed towards identifying, classifying and developing a link between the determinants of over optimism ( cognitive biases and decision making relating to cost and risk) and their impact (cost overrun). Moreover, the influence of demographic factors on the impact was also examined. Additionally, the hierarchical regression model was used to capture the systematic impact of demographic attributes and the determinants of over optimism on their impact. To summarise, the research has contributed towards formalising the relationship of contributing factors to over optimism and their impact using a combination of variance analysis and regression analysis. As revealed in the literature review, most of the cognitive bias factors are subtle and so professionals working in mega projects are, in most cases, unaware of being biased when making decisions. The findings of this research, by revealing the most important factors that cause bias, will serve as the first step in the formulation of a decision making framework that will enable project stakeholders to address different forms of bias at the planning stage of mega projects. Such a decision making tool will be of profound importance in reducing the chances of cost overruns in most projects all over the world.

According to the framed research questions, the main research contributions of this research are summarised below.

- Development of a scale for measuring cognitive biases
- Development of a scale for measuring over optimism
- The model for evaluating the relationship between determinants of over optimism and their impact was provided and
- Using this model, the research identified the determinants of over optimism that have influence on their impact in mega projects where most of the factors noted from various studies were confirmed to differ with this research.
- The researcher developed and validated the methodology used for the most important determinants of over optimism (those which associate with their impact (proxy variable)).
- The researcher also conducted an ANOVA analysis to look into any differences on the perceptions of projects on the determinants of over optimism and their impact based on 101 responses from survey questionnaire. Again, the researcher

undertook multiple regression analysis to quantify the relationship between the determinants of over optimism and their impact based on the 101 responses. The model was used to stochastically estimate the influence of the determinants of over optimism on their impact. The main aim of this research was to develop a generic model which would assist in developing contingency budgets during design stage, bidding stage, approval stage, and also during execution of the mega project thus effectively managing the impact of over optimism in mega projects.

- The major contribution in this research is therefore, the ability of this research framework to be used by businesses to model their own factors and help in their decision making not only in relation to mega projects but to other departments as well, as opposed to using subjective evidence.

### *8.6 Recommendations for Further Research*

A number of unadressed gaps heve been identified in the discussion section of this research. The identified gaps will serve as the basis of proposing new research directions that future researchers should consider.

First, it has been identified that there are more personality traits that come into play in decision making in addition to the ones evaluated in this research. The application of the big five model as the guiding theoretical framework in evaluating more personality traits will be essential in guiding future research in evaluating traits that were missed in this study. Some of the traits identified in the literature according to the model include extraversion, agreeableness, conscientiousness, emotional stability, and openness to experience. Inclusion of these in future research should reveal some interesting biases in decision making that have not been considered in this research and the other research studies conducted in the past.

The scope of this study did not allow the investigation of other factors that might be important in cost decision making such as the economic environment. A study conducted by Mišić and Radujković (2015) showed that the prevailing economic conditions is the most dominant aspect which affects the decision making process in mega projects. Future research should consider investigating the impact of the external environment in the decision making process in mega projects. This research assumed that factors in the external environment which can bias project participants are constant which might not be the case in reality. Conducting a research that considers the impact of both internal and external sources of bias in mega projects will be essential if effective interventions to combat over optimism are to be developed.

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# Appendices

*Appendix 1: Reliability Tables*

Table 4.2: Reliability for Decision-making variable

**Reliability Statistics**

| Cronbach's Alpha | Cronbach's Alpha Based on Standardized Items | N of Items |
|---|---|---|
| .688 | .703 | 16 |

Source: SPSS output

Table 4.3: Item to total statistics for DM1 to DM16

| | Scale Mean if Item Deleted | Scale Variance if Item Deleted | Corrected Item-Total Correlation | Squared Multiple Correlation | Cronbach's Alpha if Item Deleted |
|---|---|---|---|---|---|
| DM1 | 31.89 | 29.878 | .276 | .361 | .675 |
| DM2 | 32.30 | 30.951 | .207 | .282 | .682 |
| DM3 | 32.33 | 30.842 | .266 | .165 | .676 |
| DM4 | 30.95 | 31.088 | .100 | .303 | .702 |
| DM5 | 31.66 | 30.486 | .152 | .236 | .694 |
| DM6 | 32.12 | 30.726 | .249 | .369 | .678 |
| DM7 | 32.15 | 29.568 | .298 | .242 | .672 |
| DM8 | 32.43 | 30.167 | .325 | .381 | .670 |
| DM9 | 32.28 | 29.162 | .400 | .388 | .660 |
| DM10 | 32.30 | 29.211 | .432 | .458 | .658 |
| DM11 | 31.93 | 29.445 | .377 | .421 | .663 |

| | | | | | |
|---|---|---|---|---|---|
| DM12 | 31.41 | 29.564 | .287 | .278 | .674 |
| DM13 | 31.97 | 28.549 | .429 | .264 | .655 |
| DM14 | 32.02 | 29.460 | .347 | .273 | .666 |
| DM15 | 31.84 | 30.615 | .217 | .134 | .682 |
| DM16 | 32.37 | 30.234 | .366 | .266 | .667 |

Source: SPSS output

Table 4.4: Reliability of Decision-making construct after deletion of DM4

| Cronbach's Alpha | Cronbach's Alpha Based on Standardized Items | N of Items |
|---|---|---|
| .702 | .713 | 15 |

Source: SPSS output

Table 4.5: Item to total statistics after deletion of DM4 item

| | Scale Mean if Item Deleted | Scale Variance if Item Deleted | Corrected Item-Total Correlation | Squared Multiple Correlation | Cronbach's Alpha if Item Deleted |
|---|---|---|---|---|---|
| DM1 | 28.71 | 28.107 | .224 | .313 | .697 |
| DM2 | 29.12 | 28.646 | .210 | .272 | .698 |
| DM3 | 29.15 | 28.708 | .248 | .132 | .693 |
| DM5 | 28.49 | 28.392 | .135 | .231 | .714 |
| DM6 | 28.94 | 27.976 | .310 | .305 | .687 |
| DM7 | 28.97 | 27.349 | .297 | .222 | .688 |
| DM8 | 29.25 | 27.708 | .353 | .363 | .682 |
| DM9 | 29.10 | 26.650 | .438 | .357 | .671 |
| DM10 | 29.12 | 26.906 | .445 | .432 | .671 |
| DM11 | 28.75 | 26.968 | .410 | .406 | .675 |

| | | | | | |
|---|---|---|---|---|---|
| DM12 | 28.23 | 27.458 | .274 | .270 | .691 |
| DM13 | 28.79 | 26.526 | .410 | .246 | .674 |
| DM14 | 28.84 | 27.075 | .366 | .271 | .679 |
| DM15 | 28.66 | 28.346 | .217 | .134 | .698 |
| DM16 | 29.19 | 28.054 | .357 | .257 | .683 |

Source: SPSS output

Table 4.6: Reliability for Risk and Decision-making constructs

| Cronbach's Alpha | N of Items |
|---|---|
| .909 | 20 |

Source: SPSS output

Table 4.7: Reliability for Cognitive Biases constructs

| Cronbach's Alpha | N of Items |
|---|---|
| .870 | 38 |

Source: SPSS output

Table 4.8: Reliability for Personality t1 (Controllability)

| Cronbach's Alpha | N of Items |
|---|---|
| .606 | 4 |

Source: SPSS output

Table 4.9: Item to total statistics for Personality t1 (Controllability)

| | Scale Mean if Item Deleted | Scale Variance if Item Deleted | Corrected Item-Total Correlation | Cronbach's Alpha if Item Deleted |
|---|---|---|---|---|
| C1 | 10.87 | 3.513 | .319 | .588 |
| C2 | 10.53 | 3.371 | .421 | .509 |
| C3 | 10.95 | 3.048 | .539 | .413 |
| C4 | 11.01 | 3.790 | .282 | .609 |

Source: SPSS output

Table 4.10: Reliability for Personality t2 (Availability)

| Cronbach's Alpha | N of Items |
|---|---|
| .604 | 5 |

Source: SPSS output

Table 4.11: Item to total statistics for Personality t2 (Availability)

| | Scale Mean if Item Deleted | Scale Variance if Item Deleted | Corrected Item-Total Correlation | Cronbach's Alpha if Item Deleted |
|---|---|---|---|---|
| A1 | 14.08 | 5.494 | .458 | .496 |
| A2 | 13.73 | 5.458 | .432 | .509 |
| A3 | 14.52 | 5.752 | .314 | .576 |
| A4 | 15.13 | 6.533 | .222 | .614 |
| A5 | 14.02 | 5.860 | .378 | .539 |

Source: SPSS output

Table 4.12: Reliability for Personality t3 (Anchoring)

| Cronbach's Alpha | N of Items |
|---|---|
| .549 | 5 |

Source: SPSS output

Table 4.13: Item to total statistics for Personality t3 (Anchoring)

| | Scale Mean if Item Deleted | Scale Variance if Item Deleted | Corrected Item-Total Correlation | Cronbach's Alpha if Item Deleted |
|---|---|---|---|---|
| An1 | 13.00 | 4.969 | .278 | .514 |
| An2 | 13.74 | 4.048 | .281 | .523 |

| | | | | |
|---|---|---|---|---|
| An3 | 14.40 | 4.593 | .225 | .547 |
| An4 | 13.22 | 4.279 | .402 | .441 |
| An5 | 13.22 | 4.320 | .413 | .437 |

Source: SPSS output

Table 4.14: Reliability for Personality t4 (Conformation)

| Cronbach's Alpha | N of Items |
|---|---|
| .647 | 5 |

Source: SPSS output

Table 4.15: Item to total statistics for Personality t4 (Conformation)

| | Scale Mean if Item Deleted | Scale Variance if Item Deleted | Corrected Item-Total Correlation | Cronbach's Alpha if Item Deleted |
|---|---|---|---|---|
| CN1 | 14.40 | 4.323 | .445 | .571 |
| CN2 | 14.32 | 4.442 | .609 | .514 |
| CN3 | 14.71 | 4.309 | .479 | .555 |
| CN4 | 14.28 | 4.870 | .394 | .599 |
| CN5 | 15.13 | 4.801 | .185 | .720 |

Source: SPSS output

Table 4.16: Reliability for Personality t4 (Conformation) after deletion of CN5

| Cronbach's Alpha | N of Items |
|---|---|
| .720 | 4 |

Source: SPSS output

Table 4.17: Item to total statistics for Personality t4 (Conformation) after deletion of CN5

| | Scale Mean if Item Deleted | Scale Variance if Item Deleted | Corrected Item-Total Correlation | Cronbach's Alpha if Item Deleted |
|---|---|---|---|---|
| CN1 | 11.32 | 2.725 | .512 | .659 |

| | | | | |
|---|---|---|---|---|
| CN2 | 11.24 | 2.831 | .708 | .553 |
| CN3 | 11.63 | 3.084 | .386 | .735 |
| CN4 | 11.20 | 3.172 | .475 | .677 |

Source: SPSS output

Table 4.18: Reliability for Personality t5 (Cognitive Dissonance)

| Cronbach's Alpha | N of Items |
|---|---|
| .815 | 4 |

Source: SPSS output

Table 4.19: Reliability for Personality t6 (Dread)

| Cronbach's Alpha | N of Items |
|---|---|
| .553 | 4 |

Source: SPSS output

Table 4.20: Item to total statistics for Personality t6 (Dread)

| | Scale Mean if Item Deleted | Scale Variance if Item Deleted | Corrected Item-Total Correlation | Cronbach's Alpha if Item Deleted |
|---|---|---|---|---|
| D1 | 9.57 | 3.167 | .488 | .340 |
| D2 | 9.65 | 3.209 | .407 | .417 |
| D3 | 9.82 | 3.668 | .335 | .484 |
| D4 | 8.64 | 4.972 | .128 | .611 |

Source: SPSS output

Table 4.21: Reliability for Personality t6 (Dread) after deletion of D4

| Cronbach's Alpha | N of Items |
|---|---|
| .611 | 3 |

Source: SPSS output

Table 4.22: Item to total statistics for Personality t6 (Dread) after deletion of D4

| | Scale Mean if Item Deleted | Scale Variance if Item Deleted | Corrected Item-Total Correlation | Cronbach's Alpha if Item Deleted |
|---|---|---|---|---|
| D1 | 5.65 | 2.469 | .507 | .384 |
| D2 | 5.73 | 2.678 | .356 | .609 |
| D3 | 5.90 | 2.770 | .405 | .533 |

Source: SPSS output

Table 4.23: Reliability for Personality t7 (Familiarity)

| Cronbach's Alpha | N of Items |
|---|---|
| .391 | 3 |

Source: SPSS output

Table 4.24: Item to total statistics for Personality t7 (Familiarity)

| | Scale Mean if Item Deleted | Scale Variance if Item Deleted | Corrected Item-Total Correlation | Cronbach's Alpha if Item Deleted |
|---|---|---|---|---|
| F1 | 6.97 | 1.789 | .291 | .201 |
| F2 | 7.65 | 1.709 | .123 | .538 |
| F3 | 7.00 | 1.640 | .304 | .159 |

Source: SPSS output

Table 4.25: Reliability for Personality t7 (Familiarity) after deletion of F2

| Cronbach's Alpha | N of Items |
|---|---|
| .538 | 2 |

Source: SPSS output

Table 4.26: Item to total statistics for Personality t7 (Familiarity) after deletion of F2

| | Scale Mean if Item Deleted | Scale Variance if Item Deleted | Corrected Item-Total Correlation | Cronbach's Alpha if Item Deleted |
|---|---|---|---|---|
| F1 | 3.81 | .674 | .369 | . |
| F3 | 3.84 | .575 | .369 | . |

Source: SPSS output

Table 4.27: Reliability for Personality t8 (Hindsight)

| Cronbach's Alpha | N of Items |
|---|---|
| .456 | 3 |

Source: SPSS output

Table 4.28: Item to total statistics for Personality t8 (Hindsight)

| | Scale Mean if Item Deleted | Scale Variance if Item Deleted | Corrected Item-Total Correlation | Cronbach's Alpha if Item Deleted |
|---|---|---|---|---|
| H1 | 6.63 | 2.154 | .221 | .454 |
| H2 | 7.15 | 1.428 | .370 | .173 |
| H3 | 6.77 | 2.018 | .263 | .389 |

Source: SPSS output

Table 4.29: Reliability for Personality t9 (Scale)

| Cronbach's Alpha | N of Items |
|---|---|
| .117 | 2 |

Source: SPSS output

Table 4.30: Item to total statistics for Personality t9 (Scale)

| | Scale Mean if Item Deleted | Scale Variance if Item Deleted | Corrected Item-Total Correlation | Cronbach's Alpha if Item Deleted |
|---|---|---|---|---|
| S1 | 2.77 | .846 | .062 | . |
| S2 | 3.50 | .939 | .062 | . |

Source: SPSS output

Table 4.31: Reliability for Personality t10 (Representativeness)

| Cronbach's Alpha | N of Items |
|---|---|
| .124 | 3 |

Source: SPSS output

Table 4.32: Item to total statistics for Personality t10 (Representativeness)

| | Scale Mean if Item Deleted | Scale Variance if Item Deleted | Corrected Item-Total Correlation | Cronbach's Alpha if Item Deleted |
|---|---|---|---|---|
| RT_1 | 5.82 | 1.722 | -.046 | .321 |
| RT_2 | 7.09 | 1.369 | -.003 | .276 |
| RT_3 | 6.44 | 1.168 | .280 | -.482[a] |

a. The value is negative due to a negative average covariance among items. This violates reliability model assumptions. You may want to check item codings.

Source: SPSS output

Table 4.33: Reliability for Personality t11 (Optimism)

| Cronbach's Alpha | N of Items |
|---|---|
| .688 | 3 |

Source: SPSS output

Table 4.34: Item to total statistics for Personality t11 (Optimism)

| | Scale Mean if Item Deleted | Scale Variance if Item Deleted | Corrected Item-Total Correlation | Cronbach's Alpha if Item Deleted |
|---|---|---|---|---|
| O1 | 6.77 | 1.578 | .645 | .385 |
| O2 | 6.66 | 1.866 | .623 | .428 |
| O3 | 6.56 | 2.908 | .289 | .815 |

Source: SPSS output

Table 4.35:Reliability for Personality t11 (Optimism) after deletion of O3

| Cronbach's Alpha | N of Items |
|---|---|
| .815 | 2 |

Source: SPSS output

Table 4.36: Item to total statistics for Personality t11 (Optimism) after deletion of O3

| | Scale Mean if Item Deleted | Scale Variance if Item Deleted | Corrected Item-Total Correlation | Cronbach's Alpha if Item Deleted |
|---|---|---|---|---|
| O1 | 3.34 | .766 | .692 | . |
| O2 | 3.23 | .958 | .692 | . |

Source: SPSS output

Table 4.37: Reliability for Personality t12 (Venturesomeness)

| Cronbach's Alpha | N of Items |
|---|---|
| .593 | 3 |

Source: SPSS output

Table 4.38: Item to total statistics Personality t12 (Venturesomeness)

| | Scale Mean if Item Deleted | Scale Variance if Item Deleted | Corrected Item-Total Correlation | Cronbach's Alpha if Item Deleted |
|---|---|---|---|---|
| V1 | 7.39 | 1.319 | .533 | .293 |
| V2 | 7.63 | 1.454 | .284 | .692 |
| V3 | 7.14 | 1.581 | .419 | .476 |

Source: SPSS output

Table 4.39: Reliability for Personality t12 (Venturesomeness) after deletion of V2

| Cronbach's Alpha | N of Items |
|---|---|
| .692 | 2 |

Source: SPSS output

Table 4.40: Item to total statistics Personality t12 (Venturesomeness) after deletion of V2

| | Scale Mean if Item Deleted | Scale Variance if Item Deleted | Corrected Item-Total Correlation | Cronbach's Alpha if Item Deleted |
|---|---|---|---|---|
| V1 | 3.94 | .436 | .531 | . |
| V3 | 3.69 | .515 | .531 | . |

Source: SPSS output

Table 4.41: Reliability for Cognitive Biases constructs

| Cronbach's Alpha | N of Items |
|---|---|
| .847 | 31 |

Source: SPSS output

Table 4.42: Reliability for Cost Overrun factors

| Cronbach's Alpha | N of Items |
|---|---|
| .758 | 5 |

Source: SPSS output

Table 4.43: Reliability for Overall Research constructs

| Cronbach's Alpha | N of Items |
|---|---|
| .772 | 71 |

Source: SPSS output

Table 4.46: ANOVA analysis for decision-making factors based on job holder

**ANOVA**

| | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| DM1 | Between Groups | 3.919 | 4 | .980 | 1.200 | .316 |
| | Within Groups | 78.378 | 96 | .816 | | |
| | Total | 82.297 | 100 | | | |
| DM2 | Between Groups | 1.867 | 4 | .467 | .720 | .581 |
| | Within Groups | 62.271 | 96 | .649 | | |
| | Total | 64.139 | 100 | | | |
| DM3 | Between Groups | 1.591 | 4 | .398 | .788 | .536 |
| | Within Groups | 48.449 | 96 | .505 | | |
| | Total | 50.040 | 100 | | | |
| DM5 | Between Groups | 2.382 | 4 | .596 | .507 | .731 |
| | Within Groups | 112.747 | 96 | 1.174 | | |
| | Total | 115.129 | 100 | | | |
| DM6 | Between Groups | 6.036 | 4 | 1.509 | 2.736 | .033 |
| | Within Groups | 52.954 | 96 | .552 | | |
| | Total | 58.990 | 100 | | | |
| DM7 | Between Groups | 3.448 | 4 | .862 | 1.003 | .410 |
| | Within Groups | 82.512 | 96 | .860 | | |
| | Total | 85.960 | 100 | | | |
| DM8 | Between Groups | 4.858 | 4 | 1.215 | 2.232 | .071 |
| | Within Groups | 52.231 | 96 | .544 | | |
| | Total | 57.089 | 100 | | | |
| DM9 | Between Groups | 2.476 | 4 | .619 | .896 | .469 |
| | Within Groups | 66.296 | 96 | .691 | | |
| | Total | 68.772 | 100 | | | |
| DM10 | Between Groups | 8.036 | 4 | 2.009 | 3.702 | .008 |
| | Within Groups | 52.103 | 96 | .543 | | |
| | Total | 60.139 | 100 | | | |
| DM11 | Between Groups | 5.343 | 4 | 1.336 | 2.113 | .085 |
| | Within Groups | 60.697 | 96 | .632 | | |
| | Total | 66.040 | 100 | | | |
| DM12 | Between Groups | 2.108 | 4 | .527 | .574 | .682 |
| | Within Groups | 88.130 | 96 | .918 | | |
| | Total | 90.238 | 100 | | | |
| DM13 | Between Groups | 6.477 | 4 | 1.619 | 2.130 | .083 |
| | Within Groups | 72.988 | 96 | .760 | | |
| | Total | 79.465 | 100 | | | |
| DM14 | Between Groups | 1.707 | 4 | .427 | .568 | .686 |
| | Within Groups | 72.095 | 96 | .751 | | |
| | Total | 73.802 | 100 | | | |
| DM15 | Between Groups | 0.817 | 4 | .204 | .266 | .899 |
| | Within Groups | 73.856 | 96 | .769 | | |
| | Total | 74.673 | 100 | | | |
| DM16 | Between Groups | 1.160 | 4 | .290 | .617 | .651 |
| | Within Groups | 45.137 | 96 | .470 | | |
| | Total | 46.297 | 100 | | | |

Source: Information obtained from SPSS output

Table 4.47: Post Hoc tests

**Multiple Comparisons**

*Tukey HSD*

| Dependent Variable | | | Mean Difference (I-J) | Std. Error | Sig. | 95% Confidence Interval | |
|---|---|---|---|---|---|---|---|
| | | | | | | Lower Bound | Upper Bound |
| DM6 | Engineer | Project | .310 | .269 | .779 | -.44 | 1.06 |
| | | Director | .543 | .232 | .142 | -.10 | 1.19 |
| | | CEO | .343 | .370 | .885 | -.68 | 1.37 |
| | | Other | -.066 | .198 | .997 | -.62 | .48 |
| | Project Manager | Engineer | -.310 | .269 | .779 | -1.06 | .44 |
| | | Director | .233 | .271 | .911 | -.52 | .99 |
| | | CEO | .033 | .395 | 1.000 | -1.07 | 1.13 |
| | | Other | -.376 | .242 | .533 | -1.05 | .30 |
| | Director | Engineer | -.543 | .232 | .142 | -1.19 | .10 |
| | | Project | -.233 | .271 | .911 | -.99 | .52 |
| | | CEO | -.200 | .371 | .983 | -1.23 | .83 |
| | | Other | -.609* | .201 | .025 | -1.17 | -.05 |
| | CEO | Engineer | -.343 | .370 | .885 | -1.37 | .68 |
| | | Project | -.033 | .395 | 1.000 | -1.13 | 1.07 |
| | | Director | .200 | .371 | .983 | -.83 | 1.23 |
| | | Other | -.409 | .351 | .770 | -1.38 | .57 |
| | Other | Engineer | .066 | .198 | .997 | -.48 | .62 |
| | | Project | .376 | .242 | .533 | -.30 | 1.05 |
| | | Director | .609* | .201 | .025 | .05 | 1.17 |
| | | CEO | .409 | .351 | .770 | -.57 | 1.38 |
| DM10 | Engineer | Project | .583 | .267 | .193 | -.16 | 1.32 |
| | | Director | .633 | .230 | .054 | -.01 | 1.27 |
| | | CEO | 1.133* | .367 | .021 | .11 | 2.15 |
| | | Other | .589* | .196 | .027 | .04 | 1.13 |
| | Project Manager | Engineer | -.583 | .267 | .193 | -1.32 | .16 |
| | | Director | .050 | .269 | 1.000 | -.70 | .80 |
| | | CEO | .550 | .392 | .628 | -.54 | 1.64 |
| | | Other | .006 | .241 | 1.000 | -.66 | .67 |
| | Director | Engineer | -.633 | .230 | .054 | -1.27 | .01 |
| | | Project | -.050 | .269 | 1.000 | -.80 | .70 |
| | | CEO | .500 | .368 | .656 | -.52 | 1.52 |
| | | Other | -.044 | .199 | .999 | -.60 | .51 |
| | CEO | Engineer | -1.133* | .367 | .021 | -2.15 | -.11 |
| | | Project | -.550 | .392 | .628 | -1.64 | .54 |
| | | Director | -.500 | .368 | .656 | -1.52 | .52 |
| | | Other | -.544 | .348 | .524 | -1.51 | .42 |
| | Other | Engineer | -.589* | .196 | .027 | -1.13 | -.04 |
| | | Project | -.006 | .241 | 1.000 | -.67 | .66 |
| | | Director | .044 | .199 | .999 | -.51 | .60 |
| | | CEO | .544 | .348 | .524 | -.42 | 1.51 |

Source: Information obtained from SPSS output

*Appendix 2: Variance Analysis Tables*

Table 4.48: ANOVA analysis for cost decision-making factors based on experience

**ANOVA**

| | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| DM1 | Between Groups | 7.718 | 4 | 1.930 | 2.484 | .049 |
| | Within Groups | 74.579 | 96 | .777 | | |
| | Total | 82.297 | 100 | | | |
| DM2 | Between Groups | 1.966 | 4 | .491 | .759 | .555 |
| | Within Groups | 62.173 | 96 | .648 | | |
| | Total | 64.139 | 100 | | | |
| DM3 | Between Groups | 0.979 | 4 | .245 | .479 | .751 |
| | Within Groups | 49.060 | 96 | .511 | | |
| | Total | 50.040 | 100 | | | |
| DM5 | Between Groups | 6.108 | 4 | 1.527 | 1.345 | .259 |
| | Within Groups | 109.021 | 96 | 1.136 | | |
| | Total | 115.129 | 100 | | | |
| DM6 | Between Groups | 3.466 | 4 | .867 | 1.498 | .209 |
| | Within Groups | 55.524 | 96 | .578 | | |
| | Total | 58.990 | 100 | | | |
| DM7 | Between Groups | 4.443 | 4 | 1.111 | 1.308 | .273 |
| | Within Groups | 81.517 | 96 | .849 | | |
| | Total | 85.960 | 100 | | | |
| DM8 | Between Groups | 1.564 | 4 | .391 | .676 | .610 |
| | Within Groups | 55.525 | 96 | .578 | | |
| | Total | 57.089 | 100 | | | |
| DM9 | Between Groups | 1.338 | 4 | .335 | .476 | .753 |
| | Within Groups | 67.434 | 96 | .702 | | |
| | Total | 68.772 | 100 | | | |
| DM10 | Between Groups | 1.238 | 4 | .309 | .504 | .733 |
| | Within Groups | 58.901 | 96 | .614 | | |
| | Total | 60.139 | 100 | | | |
| DM11 | Between Groups | 5.165 | 4 | 1.291 | 2.036 | .095 |
| | Within Groups | 60.874 | 96 | .634 | | |
| | Total | 66.040 | 100 | | | |
| DM12 | Between Groups | 0.837 | 4 | .209 | .225 | .924 |
| | Within Groups | 89.401 | 96 | .931 | | |
| | Total | 90.238 | 100 | | | |
| DM13 | Between Groups | 2.886 | 4 | .722 | .905 | .465 |
| | Within Groups | 76.579 | 96 | .798 | | |
| | Total | 79.465 | 100 | | | |
| DM14 | Between Groups | 2.985 | 4 | .746 | 1.012 | .405 |
| | Within Groups | 70.817 | 96 | .738 | | |
| | Total | 73.802 | 100 | | | |
| DM15 | Between Groups | 0.731 | 4 | .183 | .237 | .917 |
| | Within Groups | 73.942 | 96 | .770 | | |
| | Total | 74.673 | 100 | | | |
| DM16 | Between Groups | 2.686 | 4 | .671 | 1.478 | .215 |
| | Within Groups | 43.611 | 96 | .454 | | |
| | Total | 46.297 | 100 | | | |

Source: Information obtained from SPSS output

Table 4.51: ANOVA analysis for cost decision-making factors based on culture

**ANOVA**

| | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| DM1 | Between Groups | 1.836 | 4 | .459 | .548 | .701 |
| | Within Groups | 80.461 | 96 | .838 | | |
| | Total | 82.297 | 100 | | | |
| DM2 | Between Groups | 2.113 | 4 | .528 | .818 | .517 |
| | Within Groups | 62.026 | 96 | .646 | | |
| | Total | 64.139 | 100 | | | |
| DM3 | Between Groups | 3.227 | 4 | .807 | 1.655 | .167 |
| | Within Groups | 46.812 | 96 | .488 | | |
| | Total | 50.040 | 100 | | | |
| DM5 | Between Groups | 5.380 | 4 | 1.345 | 1.177 | .326 |
| | Within Groups | 109.748 | 96 | 1.143 | | |
| | Total | 115.129 | 100 | | | |
| DM6 | Between Groups | 10.348 | 4 | 2.587 | 5.106 | .001 |
| | Within Groups | 48.642 | 96 | .507 | | |
| | Total | 58.990 | 100 | | | |
| DM7 | Between Groups | 1.048 | 4 | .262 | .296 | .880 |
| | Within Groups | 84.912 | 96 | .885 | | |
| | Total | 85.960 | 100 | | | |
| DM8 | Between Groups | 4.441 | 4 | 1.110 | 2.024 | .097 |
| | Within Groups | 52.648 | 96 | .548 | | |
| | Total | 57.089 | 100 | | | |
| DM9 | Between Groups | 1.653 | 4 | .413 | .591 | .670 |
| | Within Groups | 67.120 | 96 | .699 | | |
| | Total | 68.772 | 100 | | | |
| DM10 | Between Groups | .695 | 4 | .174 | .280 | .890 |
| | Within Groups | 59.444 | 96 | .619 | | |
| | Total | 60.139 | 100 | | | |
| DM11 | Between Groups | 2.556 | 4 | .639 | .966 | .430 |
| | Within Groups | 63.483 | 96 | .661 | | |
| | Total | 66.040 | 100 | | | |
| DM12 | Between Groups | 7.194 | 4 | 1.798 | 2.079 | .089 |
| | Within Groups | 83.044 | 96 | .865 | | |
| | Total | 90.238 | 100 | | | |
| DM13 | Between Groups | 3.755 | 4 | .939 | 1.190 | .320 |
| | Within Groups | 75.711 | 96 | .789 | | |
| | Total | 79.465 | 100 | | | |
| DM14 | Between Groups | 2.549 | 4 | .637 | .859 | .492 |
| | Within Groups | 71.253 | 96 | .742 | | |
| | Total | 73.802 | 100 | | | |
| DM15 | Between Groups | 3.557 | 4 | .889 | 1.200 | .316 |
| | Within Groups | 71.117 | 96 | .741 | | |
| | Total | 74.673 | 100 | | | |
| DM16 | Between Groups | 1.755 | 4 | .439 | .945 | .441 |
| | Within Groups | 44.542 | 96 | .464 | | |
| | Total | 46.297 | 100 | | | |

Source: Information obtained from SPSS output

Table 4.53: ANOVA analysis for project risk factors based on Job holder

**ANOVA**

| | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| R1 | Between Groups | 1.389 | 4 | .347 | .502 | .735 |
| | Within Groups | 66.453 | 96 | .692 | | |
| | Total | 67.842 | 100 | | | |
| R2 | Between Groups | 4.295 | 4 | 1.074 | 2.636 | .039 |
| | Within Groups | 38.695 | 95 | .407 | | |
| | Total | 42.990 | 99 | | | |
| R3 | Between Groups | 4.017 | 4 | 1.004 | 1.724 | .151 |
| | Within Groups | 55.343 | 95 | .583 | | |
| | Total | 59.360 | 99 | | | |
| R4 | Between Groups | 3.272 | 4 | .818 | 1.383 | .246 |
| | Within Groups | 56.788 | 96 | .592 | | |
| | Total | 60.059 | 100 | | | |
| R5 | Between Groups | 1.381 | 4 | .345 | .610 | .657 |
| | Within Groups | 53.779 | 95 | .566 | | |
| | Total | 55.160 | 99 | | | |
| R6 | Between Groups | 2.995 | 4 | .749 | .987 | .419 |
| | Within Groups | 72.847 | 96 | .759 | | |
| | Total | 75.842 | 100 | | | |
| R7 | Between Groups | 3.912 | 4 | .978 | 1.461 | .220 |
| | Within Groups | 64.286 | 96 | .670 | | |
| | Total | 68.198 | 100 | | | |
| R8 | Between Groups | 5.037 | 4 | 1.259 | 2.028 | .096 |
| | Within Groups | 59.597 | 96 | .621 | | |
| | Total | 64.634 | 100 | | | |
| R9 | Between Groups | 8.417 | 4 | 2.104 | 3.138 | .018 |
| | Within Groups | 64.375 | 96 | .671 | | |
| | Total | 72.792 | 100 | | | |
| R10 | Between Groups | 4.450 | 4 | 1.112 | 1.596 | .182 |
| | Within Groups | 66.917 | 96 | .697 | | |
| | Total | 71.366 | 100 | | | |

**ANOVA**

| | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| R11 | Between Groups | 1.484 | 4 | .371 | .534 | .711 |
| | Within Groups | 66.714 | 96 | .695 | | |
| | Total | 68.198 | 100 | | | |
| R12 | Between Groups | 1.135 | 4 | .284 | .343 | .848 |
| | Within Groups | 78.655 | 95 | .828 | | |
| | Total | 79.790 | 99 | | | |
| R13 | Between Groups | .877 | 4 | .219 | .310 | .871 |
| | Within Groups | 67.163 | 95 | .707 | | |
| | Total | 68.040 | 99 | | | |
| R14 | Between Groups | 2.800 | 4 | .700 | 1.034 | .394 |
| | Within Groups | 65.002 | 96 | .677 | | |
| | Total | 67.802 | 100 | | | |
| R15 | Between Groups | 3.381 | 4 | .845 | 1.319 | .269 |
| | Within Groups | 61.530 | 96 | .641 | | |
| | Total | 64.911 | 100 | | | |
| R16 | Between Groups | 3.599 | 4 | .900 | 1.592 | .183 |
| | Within Groups | 54.263 | 96 | .565 | | |
| | Total | 57.861 | 100 | | | |
| R17 | Between Groups | 9.346 | 4 | 2.336 | 3.859 | .006 |
| | Within Groups | 58.120 | 96 | .605 | | |
| | Total | 67.465 | 100 | | | |
| R18 | Between Groups | 9.969 | 4 | 2.492 | 3.052 | .020 |
| | Within Groups | 78.388 | 96 | .817 | | |
| | Total | 88.356 | 100 | | | |
| R19 | Between Groups | 7.777 | 4 | 1.944 | 2.496 | .048 |
| | Within Groups | 74.777 | 96 | .779 | | |
| | Total | 82.554 | 100 | | | |
| R20 | Between Groups | 5.953 | 4 | 1.488 | 1.961 | .107 |
| | Within Groups | 72.859 | 96 | .759 | | |
| | Total | 78.812 | 100 | | | |

Source: SPSS output

Table 4.61: ANOVA analysis for project risk factors based on experience

**ANOVA**

| | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| R1 | Between Groups | 1.566 | 4 | .391 | .567 | .687 |
| | Within Groups | 66.276 | 96 | .690 | | |
| | Total | 67.842 | 100 | | | |
| R2 | Between Groups | 3.224 | 4 | .806 | 1.925 | .113 |
| | Within Groups | 39.766 | 95 | .419 | | |
| | Total | 42.990 | 99 | | | |
| R3 | Between Groups | 1.953 | 4 | .488 | .808 | .523 |
| | Within Groups | 57.407 | 95 | .604 | | |
| | Total | 59.360 | 99 | | | |
| R4 | Between Groups | 4.860 | 4 | 1.215 | 2.113 | .085 |
| | Within Groups | 55.199 | 96 | .575 | | |
| | Total | 60.059 | 100 | | | |
| R5 | Between Groups | 4.410 | 4 | 1.102 | 2.064 | .092 |
| | Within Groups | 50.750 | 95 | .534 | | |
| | Total | 55.160 | 99 | | | |
| R6 | Between Groups | 5.618 | 4 | 1.404 | 1.920 | .113 |
| | Within Groups | 70.224 | 96 | .732 | | |
| | Total | 75.842 | 100 | | | |
| R7 | Between Groups | 0.994 | 4 | .248 | 0.355 | .840 |
| | Within Groups | 67.205 | 96 | .700 | | |
| | Total | 68.198 | 100 | | | |
| R8 | Between Groups | 1.049 | 4 | .262 | 0.396 | .811 |
| | Within Groups | 63.584 | 96 | .662 | | |
| | Total | 64.634 | 100 | | | |
| R9 | Between Groups | 3.794 | 4 | .949 | 1.320 | .268 |
| | Within Groups | 68.998 | 96 | .719 | | |
| | Total | 72.792 | 100 | | | |
| R10 | Between Groups | 2.526 | 4 | .631 | .881 | .479 |
| | Within Groups | 68.841 | 96 | .717 | | |
| | Total | 71.366 | 100 | | | |

**ANOVA**

| | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| R11 | Between Groups | 1.185 | 4 | .296 | .424 | .791 |
| | Within Groups | 67.013 | 96 | .698 | | |
| | Total | 68.198 | 100 | | | |
| R12 | Between Groups | 3.404 | 4 | .851 | 1.058 | .381 |
| | Within Groups | 76.386 | 95 | .804 | | |
| | Total | 79.790 | 99 | | | |
| R13 | Between Groups | 1.526 | 4 | .382 | 0.545 | .703 |
| | Within Groups | 66.514 | 95 | .700 | | |
| | Total | 68.040 | 99 | | | |
| R14 | Between Groups | 3.052 | 4 | .763 | 1.131 | .347 |
| | Within Groups | 64.750 | 96 | .674 | | |
| | Total | 67.802 | 100 | | | |
| R15 | Between Groups | 1.003 | 4 | .251 | 0.377 | .825 |
| | Within Groups | 63.908 | 96 | .666 | | |
| | Total | 64.911 | 100 | | | |
| R16 | Between Groups | 0.428 | 4 | .107 | 0.179 | .949 |
| | Within Groups | 57.434 | 96 | .598 | | |
| | Total | 57.861 | 100 | | | |
| R17 | Between Groups | 3.087 | 4 | .772 | 1.151 | .337 |
| | Within Groups | 64.378 | 96 | .671 | | |
| | Total | 67.465 | 100 | | | |
| R18 | Between Groups | 2.430 | 4 | .608 | 0.679 | .608 |
| | Within Groups | 85.926 | 96 | .895 | | |
| | Total | 88.356 | 100 | | | |
| R19 | Between Groups | 1.334 | 4 | .334 | 0.394 | .812 |
| | Within Groups | 81.220 | 96 | .846 | | |
| | Total | 82.554 | 100 | | | |
| R20 | Between Groups | 1.682 | 4 | .420 | .523 | .719 |
| | Within Groups | 77.130 | 96 | .803 | | |
| | Total | 78.812 | 100 | | | |

Source: SPSS output

Table 4.62:ANOVA analysis for project risk factors based on culture

**ANOVA**

| | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| R1 | Between Groups | 1.331 | 4 | .333 | .480 | .750 |
| | Within Groups | 66.511 | 96 | .693 | | |
| | Total | 67.842 | 100 | | | |
| R2 | Between Groups | .264 | 4 | .066 | .147 | .964 |
| | Within Groups | 42.726 | 95 | .450 | | |
| | Total | 42.990 | 99 | | | |
| R3 | Between Groups | 2.208 | 4 | .552 | .918 | .457 |
| | Within Groups | 57.152 | 95 | .602 | | |
| | Total | 59.360 | 99 | | | |
| R4 | Between Groups | 2.056 | 4 | .514 | .851 | .496 |
| | Within Groups | 58.003 | 96 | .604 | | |
| | Total | 60.059 | 100 | | | |
| R5 | Between Groups | 1.546 | 4 | .387 | .685 | .604 |
| | Within Groups | 53.614 | 95 | .564 | | |
| | Total | 55.160 | 99 | | | |
| R6 | Between Groups | 2.866 | 4 | .716 | .943 | .443 |
| | Within Groups | 72.976 | 96 | .760 | | |
| | Total | 75.842 | 100 | | | |
| R7 | Between Groups | 2.245 | 4 | .561 | .817 | .517 |
| | Within Groups | 65.953 | 96 | .687 | | |
| | Total | 68.198 | 100 | | | |
| R8 | Between Groups | 2.425 | 4 | .606 | .935 | .447 |
| | Within Groups | 62.209 | 96 | .648 | | |
| | Total | 64.634 | 100 | | | |
| R9 | Between Groups | 1.544 | 4 | .386 | .520 | .721 |
| | Within Groups | 71.248 | 96 | .742 | | |
| | Total | 72.792 | 100 | | | |
| R10 | Between Groups | 2.747 | 4 | 0.687 | 0.961 | .433 |
| | Within Groups | 68.620 | 96 | .715 | | |
| | Total | 71.366 | 100 | | | |

**ANOVA**

| | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| R11 | Between Groups | .150 | 4 | .037 | .053 | .995 |
| | Within Groups | 68.048 | 96 | .709 | | |
| | Total | 68.198 | 100 | | | |
| R12 | Between Groups | .865 | 4 | .216 | .260 | .903 |
| | Within Groups | 78.925 | 95 | .831 | | |
| | Total | 79.790 | 99 | | | |
| R13 | Between Groups | 2.921 | 4 | .730 | 1.065 | .378 |
| | Within Groups | 65.119 | 95 | .685 | | |
| | Total | 68.040 | 99 | | | |
| R14 | Between Groups | 3.958 | 4 | .990 | 1.488 | .212 |
| | Within Groups | 63.844 | 96 | .665 | | |
| | Total | 67.802 | 100 | | | |
| R15 | Between Groups | 8.735 | 4 | 2.184 | 3.732 | .007 |
| | Within Groups | 56.176 | 96 | .585 | | |
| | Total | 64.911 | 100 | | | |
| R16 | Between Groups | 1.092 | 4 | .273 | .462 | .764 |
| | Within Groups | 56.770 | 96 | .591 | | |
| | Total | 57.861 | 100 | | | |
| R17 | Between Groups | 2.215 | 4 | .554 | .815 | .519 |
| | Within Groups | 65.250 | 96 | .680 | | |
| | Total | 67.465 | 100 | | | |
| R18 | Between Groups | 2.740 | 4 | .685 | .768 | .549 |
| | Within Groups | 85.617 | 96 | .892 | | |
| | Total | 88.356 | 100 | | | |
| R19 | Between Groups | 2.076 | 4 | .519 | .619 | .650 |
| | Within Groups | 80.479 | 96 | .838 | | |
| | Total | 82.554 | 100 | | | |
| R20 | Between Groups | 7.429 | 4 | 1.857 | 2.498 | .048 |
| | Within Groups | 71.383 | 96 | .744 | | |
| | Total | 78.812 | 100 | | | |

Source: SPSS output

Table 4.63: ANOVA analysis for controllability elements on cost decision-making based on knowledge.

**ANOVA**

| | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| C1 | Between Groups | 2.101 | 4 | .525 | .643 | .633 |
| | Within Groups | 78.434 | 96 | .817 | | |
| | Total | 80.535 | 100 | | | |
| C2 | Between Groups | 4.214 | 4 | 1.054 | 1.506 | .206 |
| | Within Groups | 67.152 | 96 | .699 | | |
| | Total | 71.366 | 100 | | | |
| C3 | Between Groups | 5.265 | 4 | 1.316 | 1.859 | .124 |
| | Within Groups | 67.982 | 96 | .708 | | |
| | Total | 73.248 | 100 | | | |
| C4 | Between Groups | 2.121 | 4 | .530 | .762 | .553 |
| | Within Groups | 66.830 | 96 | .696 | | |
| | Total | 68.950 | 100 | | | |

Source: SPSS output

Table 4.64: ANOVA analysis for availability elements on cost decision-making based on knowledge.

**ANOVA**

| | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| A1 | Between Groups | 4.828 | 4 | 1.207 | 1.489 | .212 |
| | Within Groups | 77.806 | 96 | .810 | | |
| | Total | 82.634 | 100 | | | |
| A2 | Between Groups | 19.494 | 4 | 4.874 | 6.630 | .000 |
| | Within Groups | 70.565 | 96 | .735 | | |
| | Total | 90.059 | 100 | | | |
| A3 | Between Groups | 2.244 | 4 | .561 | .546 | .702 |
| | Within Groups | 98.627 | 96 | 1.027 | | |
| | Total | 100.871 | 100 | | | |
| A4 | Between Groups | 3.119 | 4 | .780 | 1.037 | .392 |
| | Within Groups | 72.188 | 96 | .752 | | |
| | Total | 75.307 | 100 | | | |
| A5 | Between Groups | 6.363 | 4 | 1.591 | 2.109 | .086 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | Within Groups | 72.410 | 96 | .754 | | |
| | Total | 78.772 | 100 | | | |

Source: SPSS output

Table 4.66: ANOVA analysis for anchoring elements on cost decision-making based on Job holder.

**ANOVA**

| | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| An1 | Between Groups | 5.254 | 4 | 1.314 | 2.667 | .037 |
| | Within Groups | 46.786 | 95 | .492 | | |
| | Total | 52.040 | 99 | | | |
| An2 | Between Groups | 2.495 | 4 | .624 | .572 | .683 |
| | Within Groups | 103.545 | 95 | 1.090 | | |
| | Total | 106.040 | 99 | | | |
| An3 | Between Groups | 1.523 | 4 | .381 | .463 | .762 |
| | Within Groups | 77.205 | 94 | .821 | | |
| | Total | 78.727 | 98 | | | |
| An4 | Between Groups | 5.884 | 4 | 1.471 | 2.485 | .049 |
| | Within Groups | 56.226 | 95 | .592 | | |
| | Total | 62.110 | 99 | | | |
| An5 | Between Groups | 7.809 | 4 | 1.952 | 3.524 | .010 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Within Groups | 52.631 | 95 | .554 | | | |
| Total | 60.440 | 99 | | | | |

Source SPSS output

Table 4.69: ANOVA analysis for conformation elements on cost decision-making based on Job holder.

**ANOVA**

| | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| CN1 | Between Groups | 6.995 | 4 | 1.749 | 2.751 | .033 |
| | Within Groups | 60.395 | 95 | .636 | | |
| | Total | 67.390 | 99 | | | |
| CN2 | Between Groups | 4.400 | 4 | 1.100 | 2.823 | .029 |
| | Within Groups | 37.402 | 96 | .390 | | |
| | Total | 41.802 | 100 | | | |
| CN3 | Between Groups | 5.794 | 4 | 1.449 | 2.420 | .054 |
| | Within Groups | 57.453 | 96 | .598 | | |
| | Total | 63.248 | 100 | | | |
| CN4 | Between Groups | 3.929 | 4 | .982 | 2.214 | .073 |
| | Within Groups | 42.586 | 96 | .444 | | |
| | Total | 46.515 | 100 | | | |

Source: SPSS output

Table 4.71: ANOVA analysis for cognitive dissonance elements on cost decision-making based on knowledge.

**ANOVA**

| | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| CD1 | Between Groups | 2.742 | 4 | .686 | .683 | .605 |
| | Within Groups | 95.298 | 95 | 1.003 | | |
| | Total | 98.040 | 99 | | | |
| CD2 | Between Groups | 4.495 | 4 | 1.124 | 1.209 | .312 |
| | Within Groups | 89.267 | 96 | .930 | | |
| | Total | 93.762 | 100 | | | |
| CD3 | Between Groups | 7.112 | 4 | 1.778 | 1.818 | .132 |
| | Within Groups | 92.888 | 95 | .978 | | |
| | Total | 100.000 | 99 | | | |
| CD4 | Between Groups | 4.117 | 4 | 1.029 | 1.148 | .339 |
| | Within Groups | 86.082 | 96 | .897 | | |
| | Total | 90.198 | 100 | | | |

Source: SPSS output

Table 4.72:ANOVA analysis for dread elements on cost decision-making based on Job holder.

**ANOVA**

| | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| D1 | Between Groups | 8.002 | 4 | 2.001 | 2.208 | .074 |
| | Within Groups | 86.988 | 96 | .906 | | |
| | Total | 94.990 | 100 | | | |
| D2 | Between Groups | 5.635 | 4 | 1.409 | 1.319 | .269 |
| | Within Groups | 102.563 | 96 | 1.068 | | |
| | Total | 108.198 | 100 | | | |
| D3 | Between Groups | 6.376 | 4 | 1.594 | 1.802 | .135 |
| | Within Groups | 84.931 | 96 | .885 | | |
| | Total | 91.307 | 100 | | | |

Source: SPSS output

Table 4.73: ANOVA analysis for dread elements on cost decision-making based on Jobholder.

**ANOVA**

| | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| F1 | Between Groups | 5.086 | 4 | 1.272 | 2.330 | .061 |
| | Within Groups | 52.379 | 96 | .546 | | |
| | Total | 57.465 | 100 | | | |
| F3 | Between Groups | 2.749 | 4 | .687 | 1.020 | .401 |
| | Within Groups | 64.677 | 96 | .674 | | |
| | Total | 67.426 | 100 | | | |

Source: SPSS output

Table 4.74:ANOVA analysis for optimism elements on cost decision-making based on Jobholder

**ANOVA**

| | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| O1 | Between Groups | 4.059 | 4 | 1.015 | 1.062 | .379 |
| | Within Groups | 91.703 | 96 | .955 | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | Total | 95.762 | 100 | | | |
| O2 | Between Groups | 7.152 | 4 | 1.788 | 2.473 | .049 |
| | Within Groups | 69.402 | 96 | .723 | | |
| | Total | 76.554 | 100 | | | |

Source: SPSS output

Table 4.75:ANOVA analysis for venturesomeness elements on cost decision-making based on Jobholder.

**ANOVA**

| | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| V1 | Between Groups | 4.549 | 4 | 1.137 | 2.326 | .062 |
| | Within Groups | 46.936 | 96 | .489 | | |
| | Total | 51.485 | 100 | | | |
| V3 | Between Groups | 2.921 | 4 | .730 | 1.722 | .151 |
| | Within Groups | 40.722 | 96 | .424 | | |
| | Total | 43.644 | 100 | | | |

Source: SPSS output

Table 4.76: ANOVA analysis for controllability elements on cost decision-making based on experience

**ANOVA**

| | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| C1 | Between Groups | 4.141 | 4 | 1.035 | 1.301 | .275 |
| | Within Groups | 76.393 | 96 | .796 | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | Total | 80.535 | 100 | | | |
| C2 | Between Groups | 1.120 | 4 | .280 | .383 | .820 |
| | Within Groups | 70.246 | 96 | .732 | | |
| | Total | 71.366 | 100 | | | |
| C3 | Between Groups | 4.190 | 4 | 1.047 | 1.456 | .222 |
| | Within Groups | 69.058 | 96 | .719 | | |
| | Total | 73.248 | 100 | | | |
| C4 | Between Groups | 1.682 | 4 | .421 | .600 | .663 |
| | Within Groups | 67.268 | 96 | .701 | | |
| | Total | 68.950 | 100 | | | |

Source: SPSS output

Table 4.77: ANOVA analysis for controllability elements on cost decision-making based on experience

**ANOVA**

| | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| A1 | Between Groups | 8.147 | 4 | 2.037 | 2.625 | .039 |
| | Within Groups | 74.486 | 96 | .776 | | |
| | Total | 82.634 | 100 | | | |
| A2 | Between Groups | 4.665 | 4 | 1.166 | 1.311 | .271 |
| | Within Groups | 85.395 | 96 | .890 | | |
| | Total | 90.059 | 100 | | | |
| A3 | Between Groups | 2.415 | 4 | .604 | .589 | .672 |
| | Within Groups | 98.456 | 96 | 1.026 | | |
| | Total | 100.871 | 100 | | | |
| A4 | Between Groups | 4.790 | 4 | 1.198 | 1.630 | .173 |
| | Within Groups | 70.517 | 96 | .735 | | |
| | Total | 75.307 | 100 | | | |
| A5 | Between Groups | 5.257 | 4 | 1.314 | 1.716 | .153 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | Within Groups | 73.515 | 96 | .766 | | |
| | Total | 78.772 | 100 | | | |

Source: SPSS output

Table 4.79: ANOVA analysis for anchoring elements on cost decision-making based on experience

**ANOVA**

| | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| An1 | Between Groups | 1.971 | 4 | .493 | .935 | .447 |
| | Within Groups | 50.069 | 95 | .527 | | |
| | Total | 52.040 | 99 | | | |
| An2 | Between Groups | 4.469 | 4 | 1.117 | 1.045 | .388 |
| | Within Groups | 101.571 | 95 | 1.069 | | |
| | Total | 106.040 | 99 | | | |
| An3 | Between Groups | 3.860 | 4 | .965 | 1.211 | .311 |
| | Within Groups | 74.868 | 94 | .796 | | |
| | Total | 78.727 | 98 | | | |
| An4 | Between Groups | .948 | 4 | .237 | .368 | .831 |
| | Within Groups | 61.162 | 95 | .644 | | |
| | Total | 62.110 | 99 | | | |
| An5 | Between Groups | .276 | 4 | .069 | .109 | .979 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | Within Groups | 60.164 | 95 | .633 | | |
| | Total | 60.440 | 99 | | | |

Source: SPSS output

Table 4.80: ANOVA analysis for conformation elements on cost decision-making based on experience

**ANOVA**

| | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| CN1 | Between Groups | 2.485 | 4 | .621 | .909 | .462 |
| | Within Groups | 64.905 | 95 | .683 | | |
| | Total | 67.390 | 99 | | | |
| CN2 | Between Groups | 1.518 | 4 | .379 | .904 | .465 |
| | Within Groups | 40.284 | 96 | .420 | | |
| | Total | 41.802 | 100 | | | |
| CN3 | Between Groups | 3.632 | 4 | .908 | 1.462 | .220 |
| | Within Groups | 59.615 | 96 | .621 | | |
| | Total | 63.248 | 100 | | | |
| CN4 | Between Groups | 1.219 | 4 | .305 | .646 | .631 |
| | Within Groups | 45.295 | 96 | .472 | | |
| | Total | 46.515 | 100 | | | |

Source: SPSS output

Table 4.81: ANOVA analysis for cognitive dissonance elements on cost decision-making based on experience

**ANOVA**

| | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| CD1 | Between Groups | 6.955 | 4 | 1.739 | 1.814 | .133 |
| | Within Groups | 91.085 | 95 | .959 | | |
| | Total | 98.040 | 99 | | | |
| CD2 | Between Groups | 15.065 | 4 | 3.766 | 4.594 | .002 |
| | Within Groups | 78.697 | 96 | .820 | | |
| | Total | 93.762 | 100 | | | |
| CD3 | Between Groups | 11.732 | 4 | 2.933 | 3.157 | .018 |
| | Within Groups | 88.268 | 95 | .929 | | |
| | Total | 100.000 | 99 | | | |
| CD4 | Between Groups | 5.981 | 4 | 1.495 | 1.705 | .155 |
| | Within Groups | 84.217 | 96 | .877 | | |
| | Total | 90.198 | 100 | | | |

Source: SPSS output

Table 4.84:ANOVA analysis for dread elements on cost decision-making based on experience

**ANOVA**

| | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| D1 | Between Groups | 4.401 | 4 | 1.100 | 1.166 | .331 |
| | Within Groups | 90.589 | 96 | .944 | | |
| | Total | 94.990 | 100 | | | |
| D2 | Between Groups | 3.324 | 4 | .831 | .761 | .553 |
| | Within Groups | 104.874 | 96 | 1.092 | | |
| | Total | 108.198 | 100 | | | |
| D3 | Between Groups | 3.681 | 4 | .920 | 1.008 | .407 |
| | Within Groups | 87.626 | 96 | .913 | | |
| | Total | 91.307 | 100 | | | |

Source: SPSS output

Table 4.85: ANOVA analysis for familiarity elements on cost decision-making based on experience

**ANOVA**

| | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| F1 | Between Groups | 1.542 | 4 | .386 | .662 | .620 |
| | Within Groups | 55.923 | 96 | .583 | | |
| | Total | 57.465 | 100 | | | |
| F3 | Between Groups | 4.101 | 4 | 1.025 | 1.554 | .193 |
| | Within Groups | 63.325 | 96 | .660 | | |
| | Total | 67.426 | 100 | | | |

Source: SPSS output

Table 4.86: ANOVA analysis for optimism elements on cost decision-making based on experience

**ANOVA**

| | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| O1 | Between Groups | 1.802 | 4 | .451 | .460 | .765 |
| | Within Groups | 93.960 | 96 | .979 | | |
| | Total | 95.762 | 100 | | | |
| O2 | Between Groups | 3.800 | 4 | .950 | 1.254 | .294 |
| | Within Groups | 72.754 | 96 | .758 | | |
| | Total | 76.554 | 100 | | | |

Source: SPSS output

Table 4.87: ANOVA analysis for venturesomeness elements on cost decision-making based on experience

**ANOVA**

| | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| V1 | Between Groups | 3.348 | 4 | .837 | 1.669 | .163 |
| | Within Groups | 48.137 | 96 | .501 | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | Total | 51.485 | 100 | | | |
| V3 | Between Groups | 6.571 | 4 | 1.643 | 4.254 | .003 |
| | Within Groups | 37.073 | 96 | .386 | | |
| | Total | 43.644 | 100 | | | |

Source: SPSS output

Table 4.89: ANOVA analysis for controllability elements on cost decision-making based on culture

**ANOVA**

| | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| C1 | Between Groups | 11.042 | 4 | 2.761 | 3.814 | .006 |
| | Within Groups | 69.492 | 96 | .724 | | |
| | Total | 80.535 | 100 | | | |
| C2 | Between Groups | 6.618 | 4 | 1.654 | 2.453 | .051 |
| | Within Groups | 64.748 | 96 | .674 | | |
| | Total | 71.366 | 100 | | | |
| C3 | Between Groups | 2.604 | 4 | .651 | .885 | .476 |
| | Within Groups | 70.644 | 96 | .736 | | |
| | Total | 73.248 | 100 | | | |
| C4 | Between Groups | 1.325 | 4 | .331 | .470 | .758 |
| | Within Groups | 67.626 | 96 | .704 | | |
| | Total | 68.950 | 100 | | | |

Source: SPSS output

Table 4.90:ANOVA analysis for availability elements on cost decision-making based on culture

**ANOVA**

| | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| A1 | Between Groups | 3.541 | 4 | .885 | 1.075 | .373 |
| | Within Groups | 79.092 | 96 | .824 | | |
| | Total | 82.634 | 100 | | | |
| A2 | Between Groups | 1.911 | 4 | .478 | .520 | .721 |
| | Within Groups | 88.148 | 96 | .918 | | |
| | Total | 90.059 | 100 | | | |
| A3 | Between Groups | 4.652 | 4 | 1.163 | 1.160 | .333 |
| | Within Groups | 96.220 | 96 | 1.002 | | |
| | Total | 100.871 | 100 | | | |
| A4 | Between Groups | 1.511 | 4 | .378 | .492 | .742 |
| | Within Groups | 73.795 | 96 | .769 | | |
| | Total | 75.307 | 100 | | | |
| A5 | Between Groups | 2.974 | 4 | .743 | .942 | .443 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Within Groups | 75.798 | 96 | .790 | | | |
| Total | 78.772 | 100 | | | | |

Source: SPSS output

Table 4.91: ANOVA analysis for anchoring elements on cost decision-making based on culture

**ANOVA**

| | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| An1 | Between Groups | 2.621 | 4 | .655 | 1.259 | .291 |
| | Within Groups | 49.419 | 95 | .520 | | |
| | Total | 52.040 | 99 | | | |
| An2 | Between Groups | 6.638 | 4 | 1.659 | 1.586 | .184 |
| | Within Groups | 99.402 | 95 | 1.046 | | |
| | Total | 106.040 | 99 | | | |
| An3 | Between Groups | 5.634 | 4 | 1.408 | 1.811 | .133 |
| | Within Groups | 73.094 | 94 | .778 | | |
| | Total | 78.727 | 98 | | | |
| An4 | Between Groups | .760 | 4 | .190 | .294 | .881 |
| | Within Groups | 61.350 | 95 | .646 | | |
| | Total | 62.110 | 99 | | | |
| An5 | Between Groups | 4.215 | 4 | 1.054 | 1.780 | .139 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | Within Groups | 56.225 | 95 | .592 | | |
| | Total | 60.440 | 99 | | | |

Source: SPSS output

Table 4.92:ANOVA analysis for conformation elements on cost decision-making based on culture

**ANOVA**

| | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| CN1 | Between Groups | 1.157 | 4 | .289 | .415 | .798 |
| | Within Groups | 66.233 | 95 | .697 | | |
| | Total | 67.390 | 99 | | | |
| CN2 | Between Groups | .803 | 4 | .201 | .470 | .757 |
| | Within Groups | 40.998 | 96 | .427 | | |
| | Total | 41.802 | 100 | | | |
| CN3 | Between Groups | 2.369 | 4 | .592 | .934 | .448 |
| | Within Groups | 60.879 | 96 | .634 | | |
| | Total | 63.248 | 100 | | | |
| CN4 | Between Groups | 4.203 | 4 | 1.051 | 2.384 | .057 |
| | Within Groups | 42.312 | 96 | .441 | | |
| | Total | 46.515 | 100 | | | |

Source: SPSS output

Table 4.93: ANOVA analysis for cognitive dissonance elements on cost decision-making based on culture

**ANOVA**

| | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| CD1 | Between Groups | 3.221 | 4 | .805 | .807 | .524 |
| | Within Groups | 94.819 | 95 | .998 | | |
| | Total | 98.040 | 99 | | | |
| CD2 | Between Groups | 4.037 | 4 | 1.009 | 1.080 | .371 |
| | Within Groups | 89.726 | 96 | .935 | | |
| | Total | 93.762 | 100 | | | |
| CD3 | Between Groups | 7.895 | 4 | 1.974 | 2.036 | .096 |
| | Within Groups | 92.105 | 95 | .970 | | |
| | Total | 100.000 | 99 | | | |
| CD4 | Between Groups | 4.233 | 4 | 1.058 | 1.182 | .324 |
| | Within Groups | 85.965 | 96 | .895 | | |
| | Total | 90.198 | 100 | | | |

Source: SPSS output

Table 4.94: ANOVA analysis for dread elements on cost decision-making based on culture

**ANOVA**

| | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| D1 | Between Groups | .613 | 4 | .153 | .156 | .960 |
| | Within Groups | 94.377 | 96 | .983 | | |
| | Total | 94.990 | 100 | | | |
| D2 | Between Groups | 3.636 | 4 | .909 | .835 | .507 |
| | Within Groups | 104.562 | 96 | 1.089 | | |
| | Total | 108.198 | 100 | | | |
| D3 | Between Groups | 1.895 | 4 | .474 | .509 | .730 |
| | Within Groups | 89.412 | 96 | .931 | | |
| | Total | 91.307 | 100 | | | |

Source: SPSS output

Table 109: ANOVA analysis for familiarity elements on cost decision-making based on culture

**ANOVA**

| | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| F1 | Between Groups | 5.206 | 4 | 1.302 | 2.391 | .056 |
| | Within Groups | 52.259 | 96 | .544 | | |
| | Total | 57.465 | 100 | | | |
| F3 | Between Groups | 4.314 | 4 | 1.078 | 1.640 | .170 |
| | Within Groups | 63.112 | 96 | .657 | | |
| | Total | 67.426 | 100 | | | |

Source: SPSS output

Table 4.96: ANOVA analysis for optimism elements on cost decision-making based on culture

**ANOVA**

| | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| O1 | Between Groups | .718 | 4 | .180 | .181 | .948 |
| | Within Groups | 95.044 | 96 | .990 | | |
| | Total | 95.762 | 100 | | | |
| O2 | Between Groups | 5.544 | 4 | 1.386 | 1.874 | .121 |
| | Within Groups | 71.011 | 96 | .740 | | |
| | Total | 76.554 | 100 | | | |

Source: SPSS output

Table 4.97:ANOVA analysis for venturesomeness elements on cost decision-making based on culture

**ANOVA**

| | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| V1 | Between Groups | 1.006 | 4 | .252 | .478 | .751 |
| | Within Groups | 50.479 | 96 | .526 | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | Total | 51.485 | 100 | | | |
| V3 | Between Groups | 1.095 | 4 | .274 | .618 | .651 |
| | Within Groups | 42.548 | 96 | .443 | | |
| | Total | 43.644 | 100 | | | |

Source: SPSS output

Table 4.98: ANOVA analysis for cost overrun elements based on knowledge

**ANOVA**

| | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| OV1 | Between Groups | 4.108 | 4 | 1.027 | .815 | .519 |
| | Within Groups | 119.682 | 95 | 1.260 | | |
| | Total | 123.790 | 99 | | | |
| OV2 | Between Groups | 16.159 | 4 | 4.040 | 2.970 | .023 |
| | Within Groups | 130.593 | 96 | 1.360 | | |
| | Total | 146.752 | 100 | | | |
| OV3 | Between Groups | 14.433 | 4 | 3.608 | 2.203 | .074 |
| | Within Groups | 157.211 | 96 | 1.638 | | |
| | Total | 171.644 | 100 | | | |
| OV4 | Between Groups | 8.260 | 4 | 2.065 | 1.134 | .345 |
| | Within Groups | 174.829 | 96 | 1.821 | | |
| | Total | 183.089 | 100 | | | |
| OV5 | Between Groups | 5.516 | 4 | 1.379 | .873 | .483 |
| | Within Groups | 151.612 | 96 | 1.579 | | |

| | | | | | |
|---|---|---|---|---|---|
| Total | 157.129 | 100 | | | |

Source: SPSS output

Table 4.100:ANOVA analysis for cost overrun elements based on experience

**ANOVA**

| | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| OV1 | Between Groups | 3.980 | 4 | .995 | .789 | .535 |
| | Within Groups | 119.810 | 95 | 1.261 | | |
| | Total | 123.790 | 99 | | | |
| OV2 | Between Groups | 7.604 | 4 | 1.901 | 1.312 | .271 |
| | Within Groups | 139.148 | 96 | 1.449 | | |
| | Total | 146.752 | 100 | | | |
| OV3 | Between Groups | 13.728 | 4 | 3.432 | 2.086 | .089 |
| | Within Groups | 157.916 | 96 | 1.645 | | |
| | Total | 171.644 | 100 | | | |
| OV4 | Between Groups | 10.272 | 4 | 2.568 | 1.426 | .231 |
| | Within Groups | 172.817 | 96 | 1.800 | | |
| | Total | 183.089 | 100 | | | |
| OV5 | Between Groups | 4.632 | 4 | 1.158 | .729 | .574 |
| | Within Groups | 152.496 | 96 | 1.589 | | |

| | | | | | |
|---|---|---|---|---|---|
| Total | 157.129 | 100 | | | |

Source: SPSS output

Table 4.101:ANOVA analysis for cost overrun elements based on culture

**ANOVA**

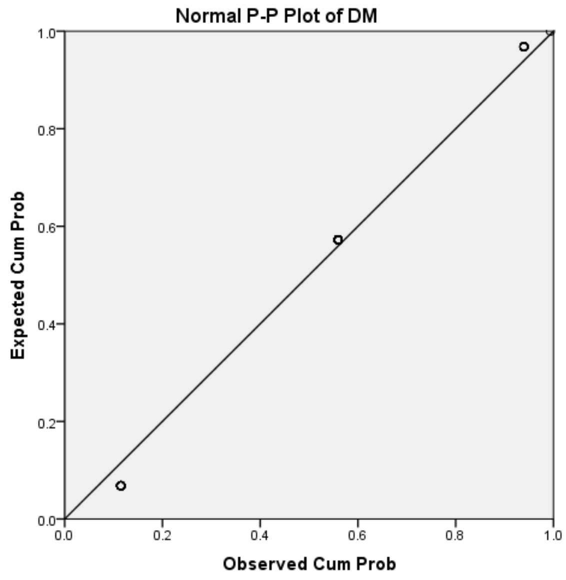
| | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| OV1 | Between Groups | 5.788 | 4 | 1.447 | 1.165 | .331 |
| | Within Groups | 118.002 | 95 | 1.242 | | |
| | Total | 123.790 | 99 | | | |
| OV2 | Between Groups | 4.824 | 4 | 1.206 | .816 | .518 |
| | Within Groups | 141.929 | 96 | 1.478 | | |
| | Total | 146.752 | 100 | | | |
| OV3 | Between Groups | 10.491 | 4 | 2.623 | 1.562 | .191 |
| | Within Groups | 161.153 | 96 | 1.679 | | |
| | Total | 171.644 | 100 | | | |
| OV4 | Between Groups | 5.647 | 4 | 1.412 | .764 | .551 |
| | Within Groups | 177.442 | 96 | 1.848 | | |
| | Total | 183.089 | 100 | | | |
| OV5 | Between Groups | 17.226 | 4 | 4.306 | 2.955 | .024 |
| | Within Groups | 139.903 | 96 | 1.457 | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Total | 157.129 | 100 | | | | |

Source: SPSS output

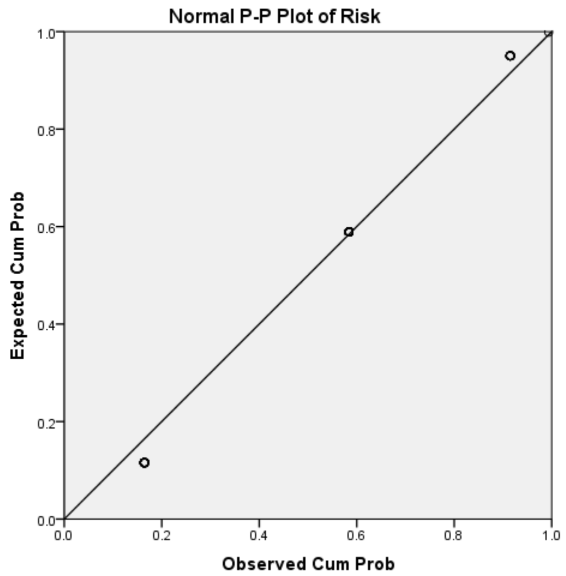
*Appendix 3: Normal P-P Plots*

Figure 25: Normal P-P Plot for Decision-making variable



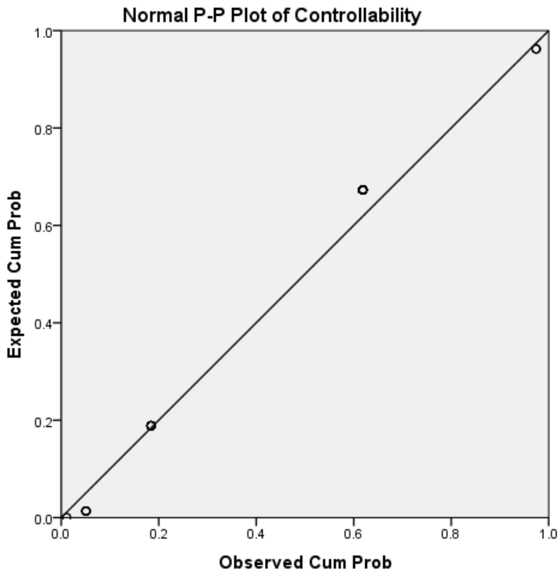

Source: SPSS output

Figure 26: Normal P-P Plot for Risk variable



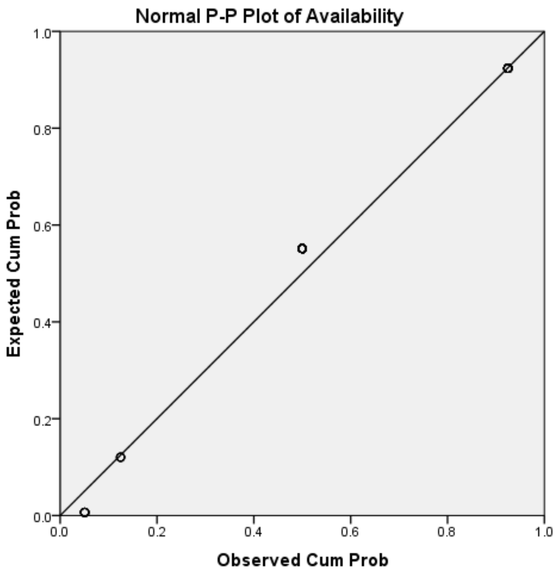

Source: SPSS output

Figure 27: Normal P-P Plot for Controllability variable



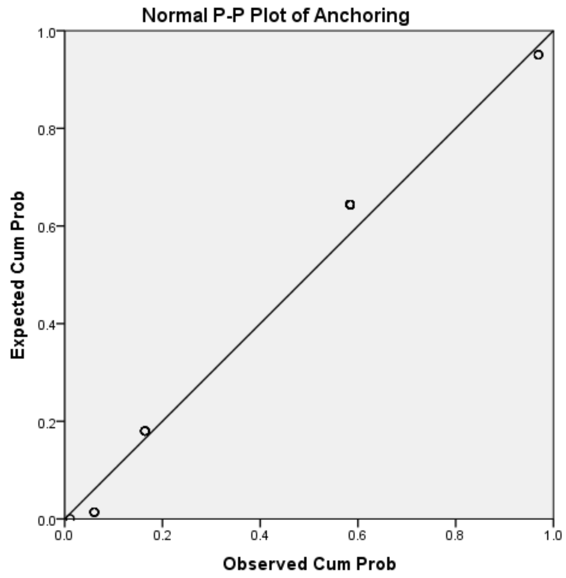

Source: SPSS output

Figure 28: Normal P-P Plot for Availability variable



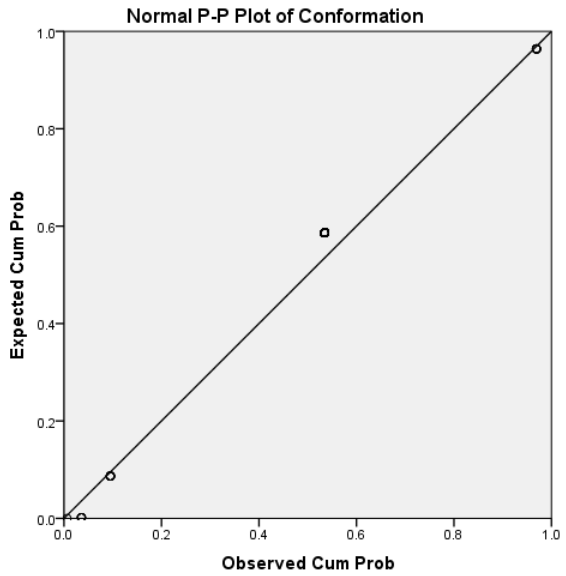

Source: SPSS output

Figure 29: Normal P-P Plot for Anchoring variable



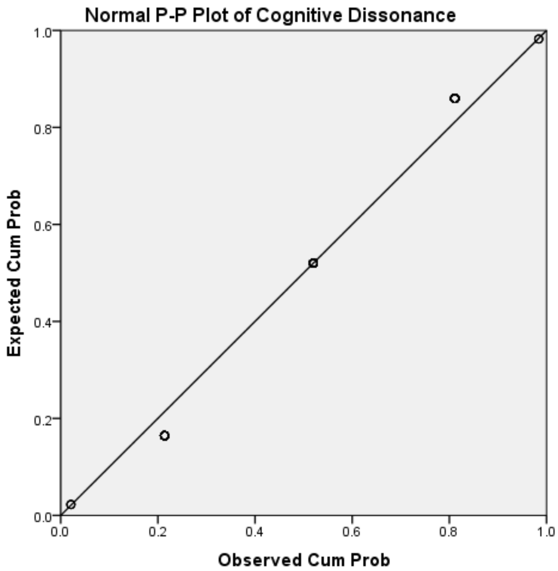

Source: SPSS output

Figure 30: Normal P-P Plot for Conformation variable



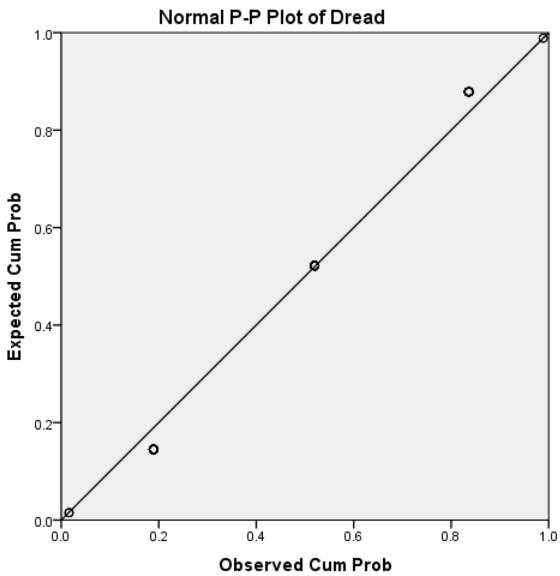

Source: SPSS output

Figure 31: Normal P-P Plot for Cognitive Dissonance variable



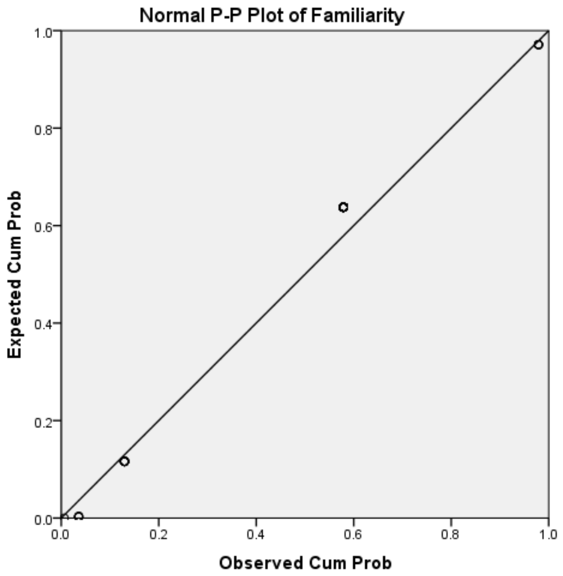

Source: SPSS output

Figure 32: Normal P-P Plot for Dread variable



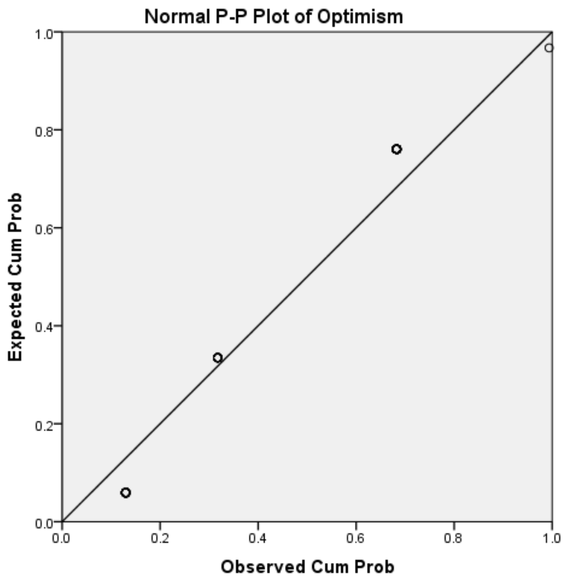

Source: SPSS output

Figure 33: Normal P-P Plot for Familiarity variable



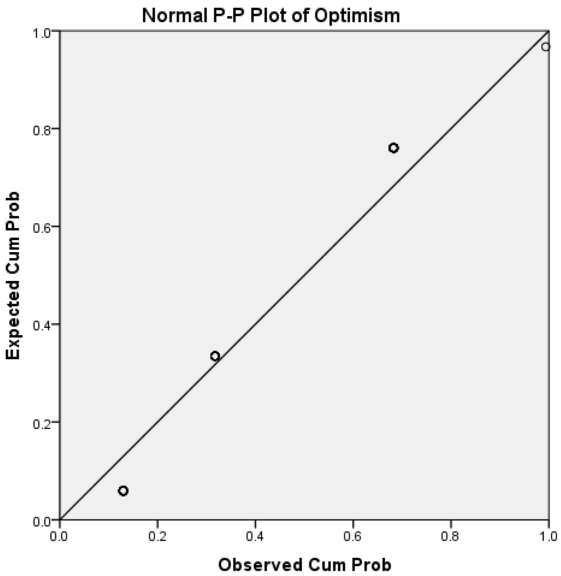

Source: SPSS output

Figure 34: Normal P-P Plot for Familiarity variable



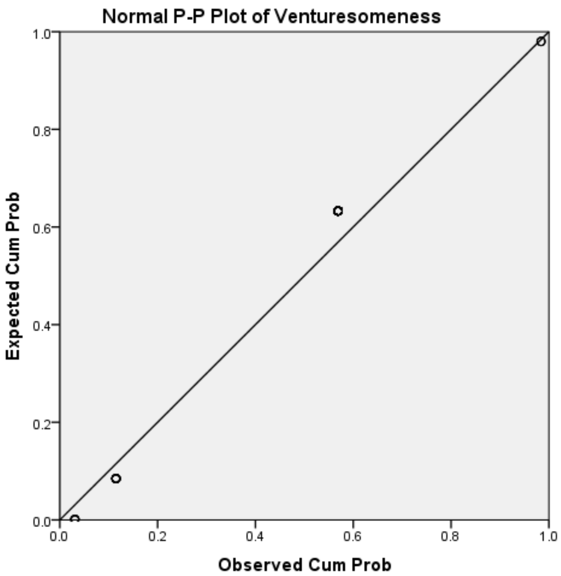

Source: SPSS output

Figure 35: Normal P-P Plot for Optimism variable



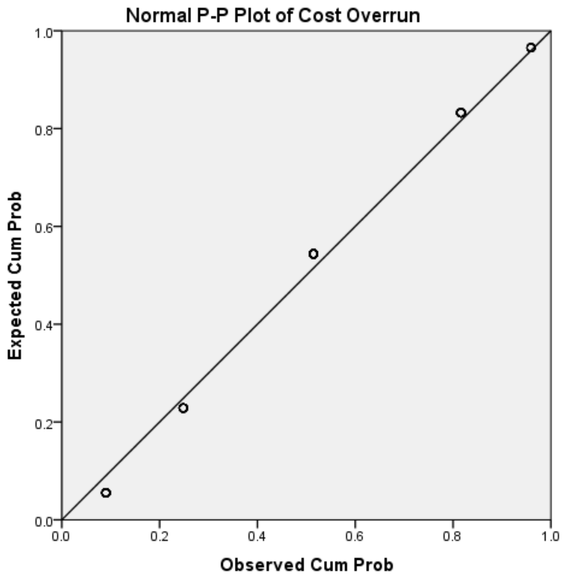

Source: SPSS output

Figure 36: Normal P-P Plot for Venturesomeness variable




Source: SPSS output

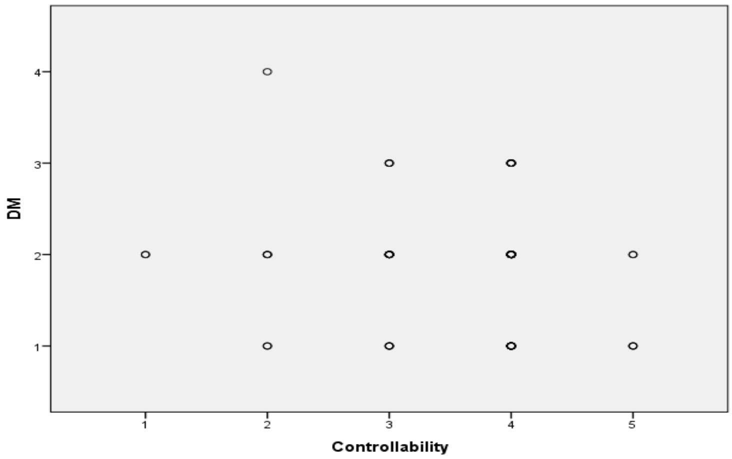
Figure 37: Normal P-P Plot for Cost Overrun variable




Source: SPSS output

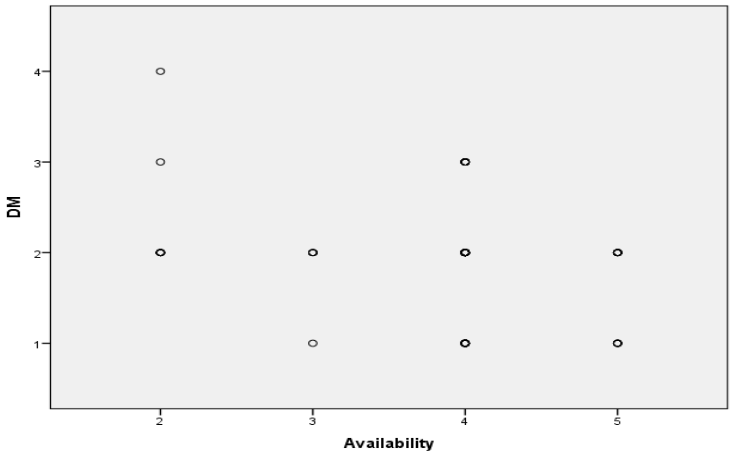
*Appendix 4: Scatter Plots*

Figure 38: Controllability and decision-making scatter plot



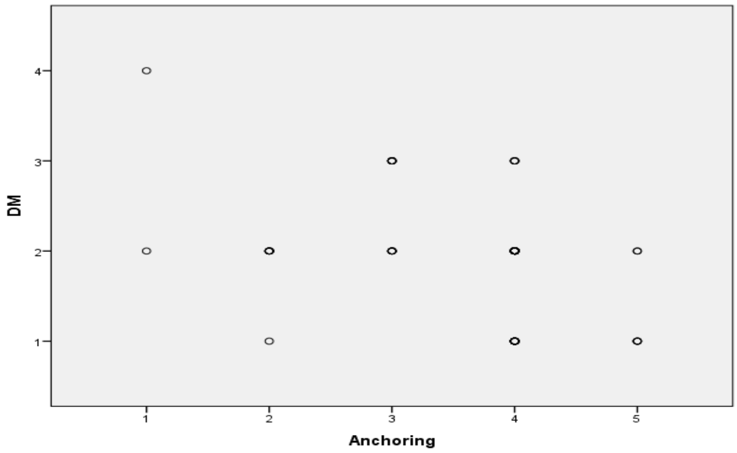

Source: SPSS output

Figure 39: Availability and decision-making scatter plot



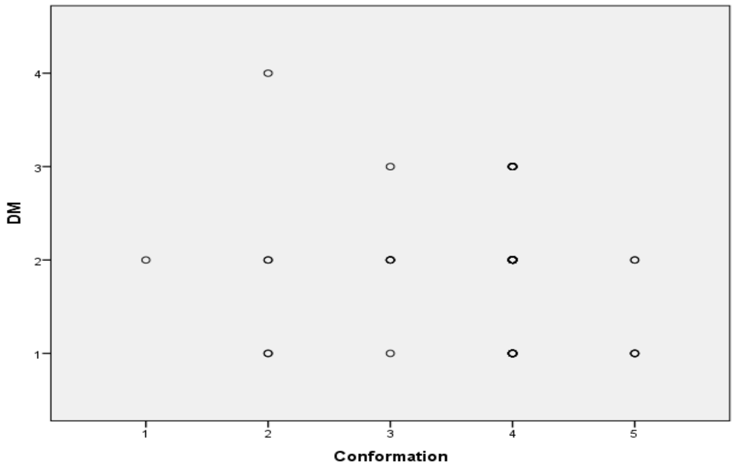

Source: SPSS output

Figure 40: Anchoring and decision-making scatter plot



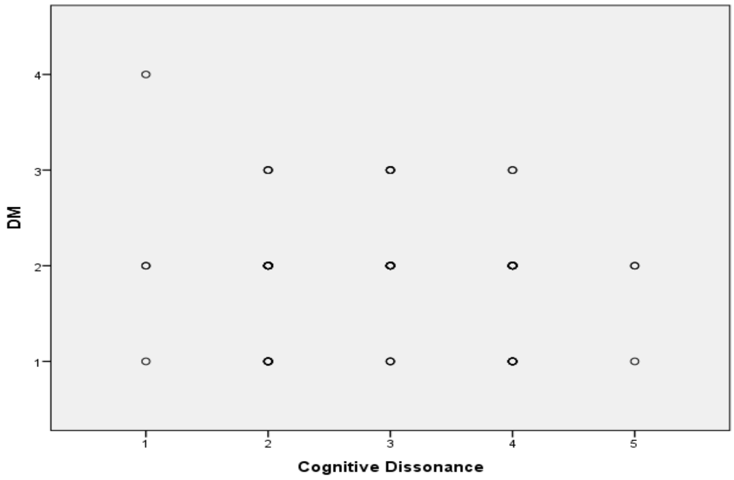

Source: SPSS output

Figure 41: Conformation and decision-making scatter plot



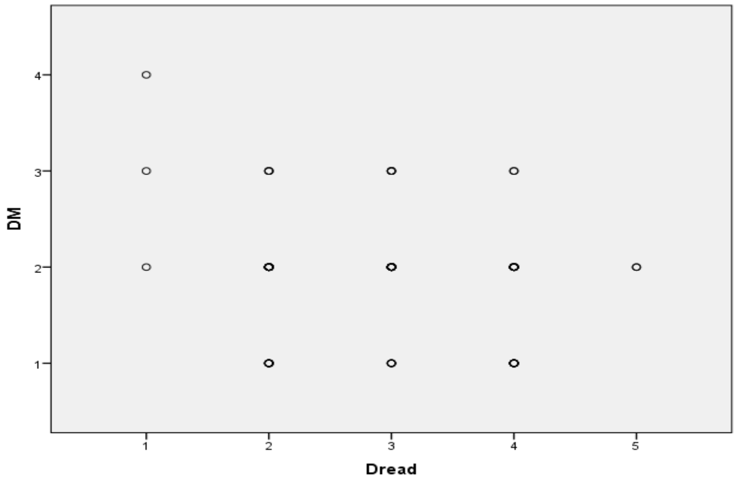

Source: SPSS output

Figure 42: Cognitive Dissonance and decision-making scatter plot



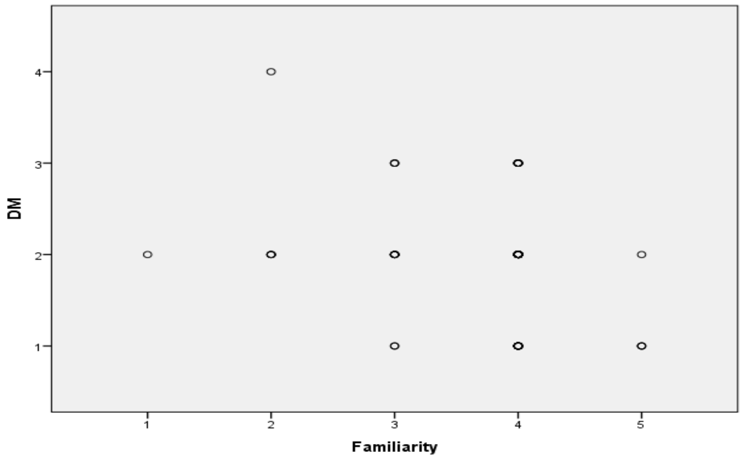

Source: SPSS output

Figure 43: Conformation and decision-making scatter plot



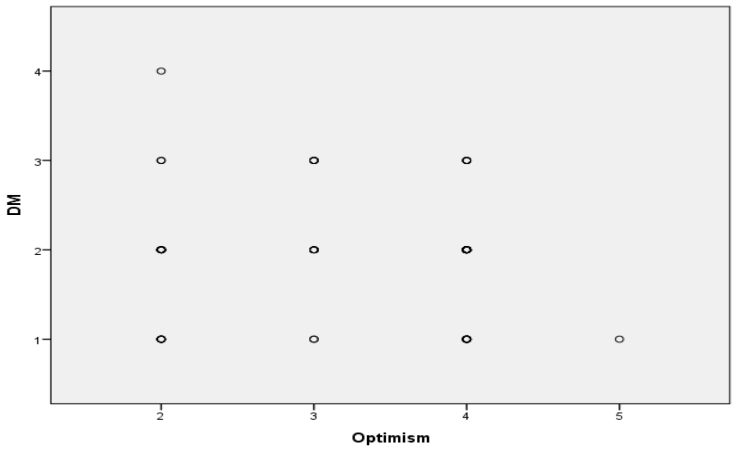

Source: SPSS output

Figure 44: Familiarity and decision-making scatter plot



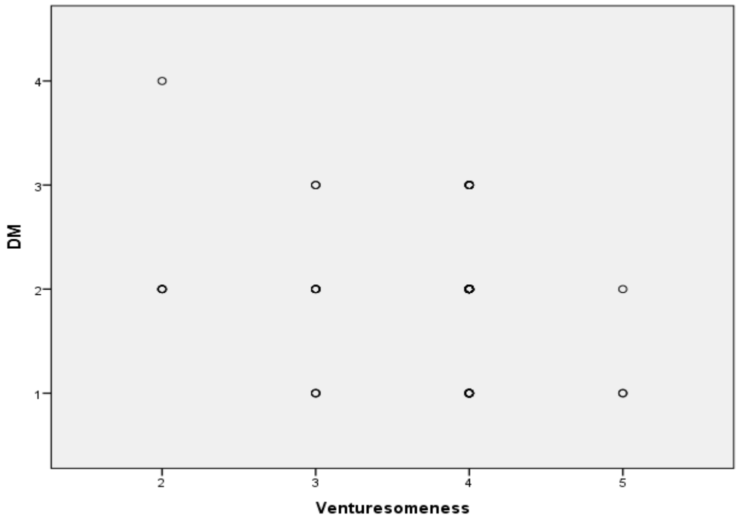

Source: SPSS output

Figure 45: Optimism and decision-making scatter plot



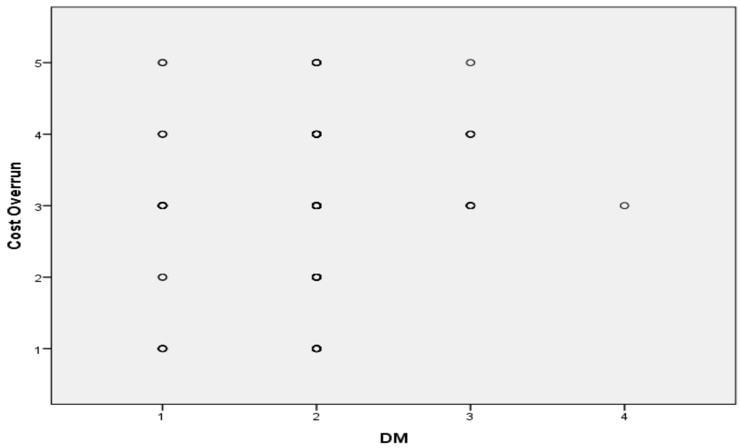

Source: SPSS output

Figure 46: Venturesomeness and decision-making scatter plot



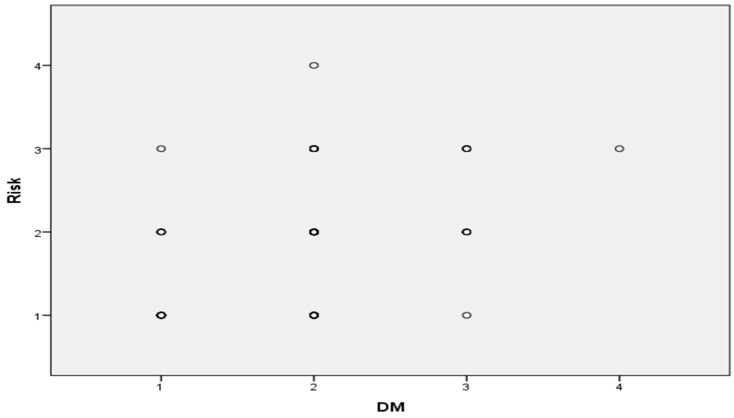

Source: SPSS output

Figure 47: Decision-making and cost overrun scatter plot



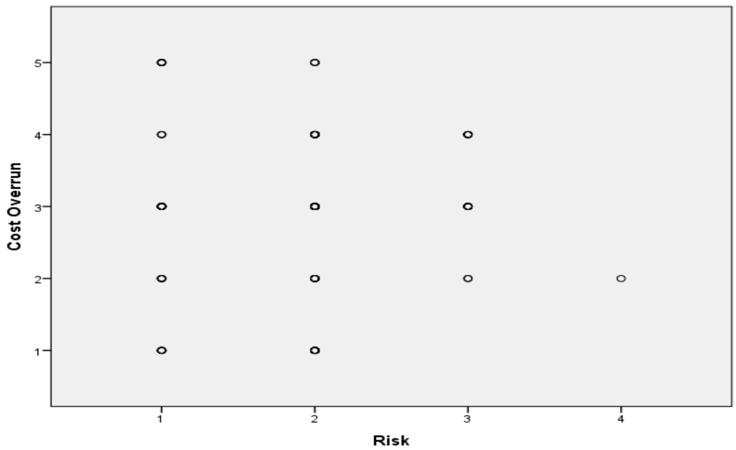

Source: SPSS output

Figure 48: Decision-making and risk scatter plot




Source: SPSS output

Figure 49: Riskand cost overrun scatter plot




Source: SPSS output

*Appendix 5 Correlation Analysis*

Table 4.103: Correlations coefficients for independent variables

**Correlations**

| | | Controllability | Availability | Anchoring | Conformation | Cognitive Dissonance | Dread | Familiarity | Optimism | Ventureso meness |
|---|---|---|---|---|---|---|---|---|---|---|
| Controllability | Pearson Correlation | 1 | .219* | .363** | .216* | .182 | -.010 | .273** | -.079 | .120 |
| | Sig. (2-tailed) | | .028 | .000 | .030 | .069 | .920 | .006 | .435 | .232 |
| | N | 101 | 101 | 101 | 101 | 101 | 101 | 101 | 101 | 101 |
| Availability | Pearson Correlation | .219* | 1 | .353** | .280** | .060 | .254* | .317** | .041 | .357** |
| | Sig. (2-tailed) | .028 | | .000 | .005 | .550 | .011 | .001 | .685 | .000 |
| | N | 101 | 101 | 101 | 101 | 101 | 101 | 101 | 101 | 101 |
| Anchoring | Pearson Correlation | .363** | .353** | 1 | .486** | .218* | .237* | .524** | .072 | .270** |
| | Sig. (2-tailed) | .000 | .000 | | .000 | .028 | .017 | .000 | .477 | .006 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | N | 101 | 101 | 101 | 101 | 101 | 101 | 101 | 101 | 101 |
| Conformation | Pearson Correlation | .216* | .280** | .486** | 1 | .086 | .181 | .215* | .184 | .250* |
| | Sig. (2-tailed) | .030 | .005 | .000 | | .392 | .070 | .030 | .065 | .012 |
| | N | 101 | 101 | 101 | 101 | 101 | 101 | 101 | 101 | 101 |
| Cognitive Dissonance | Pearson Correlation | .182 | .060 | .218* | .086 | 1 | .534** | .284** | .337** | .035 |
| | Sig. (2-tailed) | .069 | .550 | .028 | .392 | | .000 | .004 | .001 | .725 |
| | N | 101 | 101 | 101 | 101 | 101 | 101 | 101 | 101 | 101 |
| Dread | Pearson Correlation | -.010 | .254* | .237* | .181 | .534** | 1 | .187 | .390** | .305** |
| | Sig. (2-tailed) | .920 | .011 | .017 | .070 | .000 | | .061 | .000 | .002 |
| | N | 101 | 101 | 101 | 101 | 101 | 101 | 101 | 101 | 101 |
| Familiarity | Pearson Correlation | .273** | .317** | .524** | .215* | .284** | .187 | 1 | .099 | .436** |
| | Sig. (2-tailed) | .006 | .001 | .000 | .030 | .004 | .061 | | .323 | .000 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | N | 101 | 101 | 101 | 101 | 101 | 101 | 101 | 101 | 101 |
| Optimism | Pearson Correlation | -.079 | .041 | .072 | .184 | .337** | .390** | .099 | 1 | .244* |
| | Sig. (2-tailed) | .435 | .685 | .477 | .065 | .001 | .000 | .323 | | .014 |
| | N | 101 | 101 | 101 | 101 | 101 | 101 | 101 | 101 | 101 |
| Venturesomeness | Pearson Correlation | .120 | .357** | .270** | .250* | .035 | .305** | .436** | .244* | 1 |
| | Sig. (2-tailed) | .232 | .000 | .006 | .012 | .725 | .002 | .000 | .014 | |
| | N | 101 | 101 | 101 | 101 | 101 | 101 | 101 | 101 | 101 |

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

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

Source: SPSS output

*Appendix 6: Hierarchical Regression Tables*

Table 4.184: Residual Statistics

**Residuals Statistics[a]**

| | Minimum | Maximum | Mean | Std. Deviation | N |
|---|---|---|---|---|---|
| Predicted Value | 1.79 | 3.81 | 2.87 | .458 | 101 |
| Residual | -2.179 | 2.083 | .000 | 1.079 | 101 |
| Std. Predicted Value | -2.361 | 2.050 | .000 | 1.000 | 101 |
| Std. Residual | -1.895 | 1.812 | .000 | .938 | 101 |

a. Dependent Variable: Cost Overrun

Source: SPSS output

Table 4.185: Excluded Variables

| Model | | Beta In | t | Sig. | Partial Correlation | Collinearity Statistics | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Tolerance | VIF | Minimum Tolerance |
| 1 | DM | .203[b] | 2.046 | .044 | .203 | .969 | 1.032 | .948 |
| | Controllability | .153[b] | 1.539 | .127 | .154 | .987 | 1.013 | .970 |
| | Availability | .019[b] | .194 | .846 | .020 | .993 | 1.007 | .971 |
| | Anchoring | -.012[b] | -.121 | .904 | -.012 | .991 | 1.009 | .971 |
| | Conformation | .005[b] | .050 | .961 | .005 | .933 | 1.072 | .914 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Cognitive Dissonance | -.122[b] | -1.231 | .221 | -.124 | .998 | 1.002 | .977 |
| | Dread | -.187[b] | -1.902 | .060 | -.190 | .993 | 1.007 | .975 |
| | Familiarity | .050[b] | .494 | .622 | .050 | .967 | 1.034 | .948 |
| | Optimism | -.023[b] | -.232 | .817 | -.024 | .977 | 1.024 | .965 |
| | Venturesomeness | -.032[b] | -.301 | .764 | -.031 | .900 | 1.111 | .899 |
| 2 | Controllability | .178[c] | 1.817 | .072 | .182 | .975 | 1.026 | .944 |
| | Availability | .073[c] | .718 | .474 | .073 | .933 | 1.071 | .911 |
| | Anchoring | .069[c] | .654 | .514 | .067 | .862 | 1.160 | .844 |
| | Conformation | .034[c] | .331 | .741 | .034 | .916 | 1.092 | .914 |
| | Cognitive Dissonance | -.109[c] | -1.110 | .270 | -.113 | .993 | 1.007 | .946 |
| | Dread | -.155[c] | -1.558 | .122 | -.157 | .957 | 1.045 | .934 |
| | Familiarity | .107[c] | 1.045 | .299 | .106 | .908 | 1.102 | .908 |
| | Optimism | -.005[c] | -.055 | .957 | -.006 | .969 | 1.032 | .938 |
| | Venturesomeness | .003[c] | .031 | .975 | .003 | .876 | 1.142 | .876 |

a. Dependent Variable: Cost Overrun

b. Predictors in the Model: (Constant), Job Position, Work Experience

c. Predictors in the Model: (Constant), Job Position, Work Experience, DM

Source: SPSS output

Table 4.186: Collinearity Diagnostics for Hierarchical Regression model

**Collinearity Diagnostics[a]**

| Model | | Eigenvalue | Condition Index | Variance Proportions | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | (Constant) | Work Experience | Job Position | DM | Controllability | Availability | Anchoring | Conformation | Cognitive Dissonance | Dread | Familiarity | Optimism | Venturesomeness |
| 1 | 1 | 2.752 | 1.000 | .01 | .02 | .02 | | | | | | | | | | |
| | 2 | .196 | 3.747 | .00 | .36 | .50 | | | | | | | | | | |
| | 3 | .052 | 7.267 | .99 | .63 | .48 | | | | | | | | | | |
| 2 | 1 | 3.650 | 1.000 | .00 | .01 | .01 | .01 | | | | | | | | | |
| | 2 | .196 | 4.314 | .00 | .36 | .47 | .00 | | | | | | | | | |
| | 3 | .127 | 5.368 | .01 | .24 | .31 | .38 | | | | | | | | | |
| | 4 | .027 | 11.608 | .99 | .39 | .21 | .61 | | | | | | | | | |
| 3 | 1 | 12.244 | 1.000 | .00 | .00 | .00 | .00 | .00 | .00 | .00 | .00 | .00 | .00 | .00 | .00 | .00 |
| | 2 | .200 | 7.817 | .00 | .26 | .46 | .00 | .00 | .00 | .00 | .00 | .00 | .00 | .00 | .00 | .00 |
| | 3 | .152 | 8.973 | .00 | .27 | .25 | .00 | .00 | .00 | .00 | .00 | .08 | .05 | .00 | .02 | .00 |
| | 4 | .123 | 9.992 | .00 | .02 | .07 | .47 | .00 | .00 | .00 | .00 | .01 | .02 | .00 | .00 | .00 |
| | 5 | .082 | 12.236 | .00 | .27 | .10 | .03 | .04 | .04 | .04 | .01 | .10 | .04 | .01 | .03 | .00 |
| | 6 | .057 | 14.682 | .00 | .00 | .05 | .00 | .08 | .01 | .00 | .00 | .34 | .05 | .00 | .26 | .01 |
| | 7 | .043 | 16.915 | .00 | .00 | .00 | .04 | .02 | .05 | .00 | .00 | .03 | .43 | .00 | .46 | .00 |
| | 8 | .026 | 21.901 | .00 | .00 | .00 | .03 | .37 | .18 | .27 | .09 | .00 | .00 | .02 | .03 | .01 |
| | 9 | .024 | 22.362 | .00 | .01 | .01 | .00 | .37 | .22 | .02 | .05 | .14 | .22 | .13 | .01 | .02 |
| | 10 | .020 | 24.707 | .00 | .05 | .00 | .00 | .05 | .37 | .00 | .18 | .09 | .06 | .22 | .00 | .09 |
| | 11 | .013 | 30.377 | .01 | .10 | .05 | .13 | .00 | .10 | .41 | .47 | .06 | .02 | .00 | .15 | .19 |
| | 12 | .009 | 36.236 | .00 | .02 | .00 | .00 | .01 | .00 | .25 | .10 | .14 | .12 | .56 | .01 | .63 |
| | 13 | .007 | 42.745 | .98 | .02 | .00 | .29 | .06 | .03 | .00 | .10 | .00 | .00 | .06 | .03 | .04 |

a. Dependent Variable: Cost Overrun

Source: SPSS output