UNIVERSITY OF LUSAKA

SCHOOL OF POSTGRADUATE STUDIES

DEVELOPMENT OF RISK MANAGEMENT FRAMEWORK IN PUBLIC-PRIVATE PARTNERSHIP IN ZAMBIA: A CASE OF HYDROPOWER PROJECT DEVELOPMENT STAGE

BY

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A Thesis submitted to the School of Post Graduate Studies for the Degree of the Doctor of Philosophy in Project Management

2021

DECLARATION

I, Eng. Michael Kalumbu Nsefu, do hereby declare that this thesis is my original work and has not been submitted for a Doctor of Philosophy (PhD) degree to the University of Lusaka or any other University. All that is borrowed from other scholars have been acknowledged and well cited in the place where they appear.

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I have read and checked the Thesis written by Eng. Michael Kalumbu Nsefu and do hereby confirm that it meets the minimum set standards of the University of Lusaka. I, therefore, recommend an award of PhD.

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UNIVERSITY APPROVAL

I…………………………………….................and on behalf of the University of Lusaka do hereby confirm that I have read and examined the Thesis written by Eng. Michael Kalumbu Nsefu, Supervised by Dr Eng. Erastus Mwanaumo and Co-Supervised by Dr Stephen Gumboh. I, therefore, approve/not approve of this research work.

Full Name………………………………………..

Signature…………………………………………

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Full Name ________________________________

Signature ________________________________

Date ________________________________

DEDICATION

A special dedication to my beloved wife Theresa Musa Hassab, mother Ruth Chilonga, son Ryan, Daughters Kampamba and Melissa.

ACKNOWLEDGEMENTS

It was a lonely journey and sometimes I would open my laptop for days without shutting it down for fear of losing my thoughts. However, my supervisors, friends, family members and fellow PhD candidates at the University of Lusaka and other international universities encouraged me to tread on the path. I also acknowledge the partial scholarship the University of Lusaka rendered to me including the part-time lecturing position that enhanced my studies. So many people some of whom I may have forgotten helped with various needs to build this document. Exceedingly, I express my gratitude to all those who encouraged and helped me directly or indirectly on this journey.

Most sincerely, I wish to thank my Supervisors Dr Eng. Erastus Mwanaumo and Dr Stephen Gumboh for guiding me meticulously in conducting the study and finally in writing the Thesis. I will remain greatly indebted to them for their commitment and dedication to academic work.

My sincere gratitude goes to the University of Lusaka management team and support staff for their tireless support and scholarship. I, also thank my employer Zambia Metrology Agency for the support while I was undergoing this journey.

Special thanks go to my wife Theresa Musa Hassab, mother Ruth Chilonga, son Ryan, daughters Kampamba and Melissa and friends Chomba Mulenga, James Mwanza for the support they gave me and indeed all my friends too numerous to mention who helped me with little things that I could not have done without in my studies.

MOTIVATION

Change is inevitable in this global village, thus, to keep up with change, it is morally right to continuously seek knowledge and be more fully engaged in finding solutions to communal problems. Further, the enthusiasm is drawn from understanding the ontological positioning of the reality surrounding both the internal and external worlds of the risk management in mega construction projects finalized through Public-Private Partnership in Zambia.

Successively, it is interesting to draw on the epistemological perspectives to understand the source, limitations, and nature of knowledge regarding the risk management culture on complex Public-Private Partnership Projects in Zambia. Thus, the study aimed to ensure project success once the inherent risks are identified, analyzed, allocated to the party with the capacity to manage and mitigate complex projects. Projects aimed at achieving value for money and sustainability of energy infrastructure contributes to the social-economic development of the country.

An added benefit, as a result, is the attainment of Doctoral qualifications that would further support lecturing, research and consultancy services. Furthermore, to create a reservoir through publications emanating from such activities.

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ACRONYMS AND ABBREVIATIONS

ACEI	Association of Consulting Engineer of Ireland
ACEZ	Association of Consulting Engineers of Zambia
ADB	Asian Development Bank
AfDB	African Development Bank
AU	African Union
BDO	Build Develop Operate
BOM	Build Own Maintain
BOO	Build Own Operate
BOT	Build Operate Transfer
CSF	Critical Success Factor
DBFO	Design Build Finance Operate
DBO	Design Build Operate
DFDI	Foreign Direct Investments
FIDIC	International Federation of Consulting Engineers
GCC	General Conditions of Contract
GDP	Gross Domestic Product
GRZ	Government of Zambia
DCMF	Design Construct Manage Finance
GDP	Gross Domestic Product
HPP	Hydro Power Project
IMF	International Monetary Fund
IRR	Internal Rate of Return
LCC	Lusaka City Council

MENA	Middle East and North Africa
MFD	Macro Funders and Developers
NPV	Net Present Value
PFI	Public Financing Initiative
PPP	Public-Private Partnerships
ROI	Return on Investment
SDG	Sustainable Development Growth
SPSS	Statistical Package for Social Sciences
SPV	Special Purpose Vehicle
UNDP	United Nations Development Programme
UNECA	United Nations Economic Commission for Africa
UNESCAP	United Nations ….
VfM	Value for Money
WB	World Bank
ZDA	Zambia Development Agency
7NDP	Seventh National Development Plan

ABSTRACT

The concept of Public-Private Partnership (PPPs) being applied in the implementation of energy infrastructural projects such as hydropower projects is a fundamental transformation development. Hydropower Power Projects (HPP) are known to be site-specific and requires huge investment coupled with long gestation periods. These characteristics expose hydropower projects to risks and uncertainties that include economic, environmental, social, hydrology, geological, regulatory, political, technological, financial, climate, natural, and safety. Without a well-designed risk management framework, this leads to project delays, cost overruns that subsequently poor or non-availability of energy generation and infrastructure sustainability. This study, therefore, developed a risk management framework specific for HPP/PPP and responded to the general question on how risks can be effectively managed on hydropower projects finalized under Public-Private Partnership in Zambia. Pragmatism was the philosophical view that underpinned the study. The sequential exploratory mixed research method approach was used. The qualitative component was handled using a literature survey, interviews with experts and Delphi Technique. The Delphi method comprised twenty-two experts on a three-round Tier. While the interview guide was used for fifteen experts in HPP/PPP who were chosen through snowball and purposive sampling techniques. The entire identified population which consists of sixty experts responded to the questionnaire survey regarding technical inputs to the framework. The three streams of qualitative data were analyzed through the Delphi Technique, content analysis and the inductive process of building from the data to broad themes and then to a generalized model or theory. Quantitative data was analysed by using the mean score analysis on the probability and impact of the risks, multiple regression on various independent variables and dependent variables, and Chi-square tests to ascertain the hypothesis of the study. The reliability of the five-point Likert scale used in the survey questionnaire was tested for internal consistency using the Cronbach's coefficient. The findings from the study revealed that risk is inherent in the various components of the project development stage, with the planning stage bearing more risks (Technical 56.8%, Contractual 38%, Financial 43.5% and Regulatory & Legal 46.7%). Social/Environmental risks were more at the feasibility stage bearing 52%. The risk allocation is done to the project partners (private entity, public entity, or equal sharing) based on their knowledge and capacity to manage them. The study further deduced that allocating more risks to the private sector is not an economically viable decision as the cost is more on the public sector once the project is not delivered on time or abandoned due to financial risks or force majeure. Likewise, the misallocation of risks has a highly significant correlation to the main grounds of conflicts and disputes during construction and operation phases of PPP Infrastructure projects resulting in non-attainment of Value for Money and pitiable sustainability of the project. The study recommended the integration of a risk management culture at the project development stage of HPP/PPP. Further recommends continuity of the agreements entered into with the previous governments once there is an administration change. Continuous training and development of obtaining innovative and entrepreneurship standards in risks management must be enhanced. And finally, the insurance of HPP/PPP against political risks must be explored. Well implemented risk management framework enhances project stakeholder's relationship that aid collaboration resulting in reduced project risks. The study is imperative as the outcome may form a foundation for more efficient delivery of HPP/PPP by enhancing the probability of success, attainment of value for money and infrastructure sustainability.

KEYWORDS: Allocation, Hydro Power, Impact, Partnership, Probability Risk, Sustainability.

CHAPTER ONE

INTRODUCTION AND BACKGROUND

1.1 General Introduction of the Research

Many developing nations have adopted new energy policies and laws to encourage private investment in renewable energy (RE) sources(Owen, 2016). Many governments are in search of diverse financing, legal and commercial frameworks, as well as public-private partnerships (PPPs) to leverage private capital and expertise to support the development of energy projects(Md Lasa et al., 2018; Thiemann & Volberding, 2017). The PPP phenomenon has been highly endorsed due to the integration of project need analysis, effective risk management, accountability, innovativeness, creativity and networking approach in infrastructure development between the private sector and the hoisting governments.

Despite, the promotion of private investment in renewable energy specifically in hydropower projects, some challenges leads to project delays, termination, inadequate design, contractual disputes and project terminations(Lee et al., 2018a). In the Zambian setup, which is highly dependent on hydropower projects, this sector encounters hydrological and climatic variability on the entire Zambezi and Kafue River Basin where major hydro projects (Batoka, Itezhi Tezhi, Kafue Gorge and Kariba) are situated(Ernst and Young, 2017; Tembo, 2012). The projects also have experienced an extreme decline in water levels resulting in the poor generation of power in recent years. Accordingly, hydropower projects are competing with other renewable energy sources such as solar and wind energy. Thus, this research attempted to explore, analyse, allocate and mitigate the risks associated with hydropower projects finalized through PPP. It also developed technical inputs for the Risk Management Framework with a supplement Risk Register for HPP/PPP. It is envisaged that this intervention at the pre-concession stage of HPP/PPP in Zambia would significantly contribute to the attainment of value for money and sustainability of the hydro infrastructure projects.

Henceforth, this chapter presents the introduction and background of the study in line with the research topic. Further, it outlines the statement of the problem, the objectives, research questions, research variables. Subsequently, it discusses the significance, scope and road map of the thesis. The chapter ends in a conclusion and precedes Chapter Two- Literature Review.

1.2 Background of the Study

1.2.1 Development of Energy Infrastructure

The infrastructure development of any nation refers to the construction, repair, renovation, and upgrading of both Green & Brownfield projects consisting of power plants, water plants, Information Communication Technology, water reticulation, drainage, roads, and airports (Cheung, 2009). The availability of quality renewable energy infrastructure contributes greatly to the social-economic growth of any nation (Shediac et al.,2008; Kodongo & Ojah, 2016). As of the year 2010, Hydropower was cited as the most widely used form of renewable energy commanding about 16 per cent of the world's electricity consumption due to its low cost, environment-friendly, and dependence on well-proven technology (Jamal et al.,2014; Sciences, 2013; Tp-a-, 2011; Singh & Nachtnebel, 2015). However, most large hydropower projects have received a lot of disapproval from environmental activists and local communities (Jamal et al.,2014), also projects are characterized by poor project designs, cumbersome procurement processes, climate change risks, costly delays and in some cases total project failure (Batool & Abbas, 2017; Braeckman & Guthrie, 2016; Burger & Hawkesworth, 2011). From a techno-commercial point of view, Drahansky et al. (2016) explain that hydropower projects require huge capital investment, long construction periods, and suitable geological and topological conditions. It is these features that expose hydropower projects to various uncertainties and risks affecting the achievement of value for money (Takim et al., 2011) and sustainability (Osei-Kyei & Chan, 2017; Sharma & Kar, 2018).

However, what is more, a cardinal is being able to develop the structures cost-effectively, with the quality, timely execution, and obtained value for money. But how is this possible with the inherent risks embedded in these major projects plus the high project financing needed? This is what this research attempts to solve.

1.2.2 Demand for Infrastructure Development

Robust and reliable infrastructure development is the basis of any country's economic and social well-being (Banda et al., 2017). Between 2015 and 2020, it was estimated that $4.5 trillion per year capital investment was required for the developing countries (UNCTAD,2014; Peuple & Costantinos, n.d.).Infrastructure projects are mainly undertaken to satisfy human needs and are vital for national economic growth (Rahman et al.,2014). Worldwide, about 1.3 billion people lack access to electricity due to underdeveloped generation capacity and electrical grids. One (1) billion people live in areas that are more than two (2) kilometres to an all-weather road (Runde et al., 2016). This indicates that a lot must be done to identify the infrastructure needs in meeting the growing demands. Without strategic planning and identification of infrastructure, there is a risk of planning and developing infrastructure which does not provide the needed solutions.

Meeting high demand for the energy infrastructure which requires huge capital investments and is characterized by several inherent risks, requires the systematic collaboration of the private and public sectors (Mazher, Chan, & Zahoor, 2017; World Economic Forum, 2016). This collaboration is termed as Public-Private Partnership (PPP) that has been on the rise in both developed and developing nations as a means of financing projects and provision of technical expertise in mitigating infrastructure challenges (Nguyen et al., 2017). World Bank (2017) states that with a lack of fiscal constraints, governments around the world elect the private sector to develop and operate public infrastructure. World Bank elaborates its definition as "a long-term contract between a private party and a government entity, for providing a public asset or services, in which the private party bears significant risk and management responsibility, and remuneration is linked to performance".

In Asia, despite, development at a faster rate, over 400 million Asians do not have access to basic infrastructure needs (Lee et al., 2018a). An estimated annual investment of USD 1.7 trillion, which includes climate mitigation and adaptation costs, is needed across Asia from 2016–2030 for energy infrastructure (Deep et al., 2019). This shows a substantial financing gap to support infrastructure development. This is intensified by governments grappling with fiscal deficits. These financial challenges have led policymakers to look at the Public-Private Partnership in closing the infrastructure gaps (Deep et al., 2019). The number of projects executed with the collaboration with the private sector that reached financial closure in developing Asia between 1991 and 2015 accelerated by an annual growth rate of 11% (ADB 2017a). Projects finalized using a partnership model (PPP) in developing Asia accounts for half of all PPPs in developing countries. More than 70% are in East Asia and South Asia, and 90% of that share is in India and China. There has been a drastic increase in the use of PPP models in Indonesia, Malaysia, the Philippines, Thailand, and Viet Nam. Central Asia and the Pacific together account for only 2% of the region's PPPs (Deep et al.,2019; Lee et al.,2018). This increased number must have come up due to the benefits associated with PPP that this research strived to explore.

Several infrastructure development projects in the United Kingdom, France, Canada, China, Germany, and the Netherlands were developed through the PPP model (Osei-Kyei and Chan 2017). The private sector having full confidence in these countries' markets due to maturity in their institutional, environmental, and market conditions are the reasons (Osei-Kyei and Chan 2017; Wang, Liu, Xiong, & Zhu, 2018). Hence, the willingness by the private sector to bring in more investments in the economy, calls for the policymakers in the developing nations to work extra hard to ensure that the business markets and the environment is favourable for the private sector to invest in. Gaillard (2010) defines a developing country as a nation that has a comparatively truncated standard of living, with an embryonic industrial base and a moderate-to-low Human Development Index (HDI) score including per capita income.

There has been fast economic growth in China leading to massive infrastructure development projects in which the Chinese government projected to cost about four trillion yuan ($586 billion) (Ke, Wang, & Chan, 2012). In 2008, the Chinese Government projected a 4 trillion RMB stimulus plan of this figure, only about 1.18 trillion RMB ($170.5 billion) came from the government, the remaining amount was raised from the private sector (Yuan et al., 2010; Cheung et al., 2010; Ke et al., 2009; Ke et al.,2012). In this case, it has been observed that even nations with a stable and large economic state, also utilizes the resources from the private sector. Thus, developing nations facing financial constraints cannot continue financing projects using the traditional method (government budgets) but must embrace the private sector financing technique through a partnership. However, this is only possible if the hoisting governments create an enabling environment (Rajput, 2019).

Africa has the potential to increase its infrastructure to achieve fundamental transformation and market amalgamation. And this can be achieved by tapping into private foreign finances (Arezki & Sy, 2016). Hall (2018) asserts that there is a network of international institutions, various governments, and corporate bodies that actively promotes PPPs through marketing and capacity building. These include the World Bank, Regional Development Bank, European Banks EIB, European Bank for Reconstruction and Development (EBRD) and International Monetary Fund (Hall,2018). The World Bank has a private sector funding arm known as International Finance Corporation (IFC) while the World Bank itself lends directly to governments (Yong, 2010; Hall,2015; Pilcher et al., 2004). Nevertheless, the case of PPP infrastructure projects in Liberia, one of the developing countries shows that rampant corruption, poor legal and regulatory framework, inexperienced local financing structures capabilities, insufficient institution capacity in comprehending PPP agreements, and political interference are among the major risks encountered (Tweh,2018). This research strived to analyze how hydropower projects can be successfully executed through the PPP model as a substitute for the traditional procurement technique despite the various inherent risks associated with hydropower construction projects.

By the early 2000s, various governments in Africa spent a total of US$45 billion annually on infrastructure. The financing of the projects was mainly from domestic financing sources(Warner et al.,2019; Allie, 2018). Of the US$45, approximately US$17 billion was lost due to inefficiencies, obtained from distribution losses, low revenue collection, underrepresenting of services, poor maintenance, and poor execution of capital budgets (Allie, 2018). Hence, this research endeavoured to enlighten the paybacks of using the PPP prototype in executing hydropower projects. The question of what the private sector brings on board apart from financing in PPP models has been explained in this chapter.

According to Arimah (2017), the growth of African cities are directly dependent on the extent to which infrastructure is sufficiently provided, upgraded, and sustained. This is because countries around the world that have been most successful in attracting investment and increasing their competitiveness are those that improved the range and quality of their infrastructure (Arimah, 2017). Having the quality infrastructure in developing nations is not as easy as there is a need for capacity building in project financing citing millions of dollars which are lost during the project execution due to corruption and poor technical expertise (Hall, 2015; Aldrete et al., 2010; World Bank, 2009; European Union, 2004). Corruption, poor technical expertise are among the many risks that thwart obtaining value for money on infrastructure projects even where adequate resources have been sourced and mobilized. It is in this contextual that this research attempted to develop a risk management framework that identifies and analyzes the various risk factors which inhibit project success and recommends the optimal risk allocation in mitigating the identified risks.

Further, Arimah (2017) asserts that developing nations that have failed to move in the same space with other countries in the provision of adequate infrastructure suffer from restricting economic growth. Furthermore, it leads to countries being less prosperous and untenable in terms of balancing economic, social development, and environmental status (Arimah, 2017). An indication of adequate investment in infrastructure is crucial for the success of sustainable development goals. Hence, governments need to embrace the initiatives of attracting financing of such huge capital investment projects and not depending on the traditional method of financing only (Nguyen et al., 2017). According to the United Nations (2019), to meet the challenges being faced by most developing nations, total annual financing needs are estimated to range between $4.6 trillion and $7.9 trillion at the global level. Securing the finance for infrastructure investment is what must be well understood by the countries which are still lagging in terms of development (Yescombe, 2017; Ke et al., 2012). Governments in developing nations struggle to manage and sustain infrastructure development using the traditional method of financing instead of adopting project financing as the key (Deep et al., 2019). The private sector and other cooperating partners have been evidenced to be the solution for financing infrastructure developments when there is a commitment from the hoisting government, assurance of support and cooperation from the government, including political and economic stability (Loxley, 2013; ZDA, 2014; McQuaid, 2019; Marques & Berg, 2011).

1.2.3 Challenges in Infrastructure Development

Studies assert the importance of infrastructure development (Zhao et al.,2018). Johnson et al. (2017) contend that poverty reduction is seldom the specific objective of these huge projects. Scott and Seth (2012) state that the poor are the last to benefit from, infrastructure projects. Furthermore, Alexander (2013) emphasizes that large infrastructure projects do negatively affect the poor as it destroys the social fabric of local cultures, key habitats for native biodiversity, and the natural resources upon which their existence depends. This infrastructure development though cardinal for social-economic benefits have several inherent risks. This calls for a well-designed risk management framework at the project development stage to ensure there is an achievement of project success and sustainability for all classes of citizens. Consequently, social benefits should be incorporated into the design and planning of infrastructure projects (McIntyre et al. 2008; Bosshard 2012; Alexander 2013; Johnson et al., 2017).

For the Private sector to work effectively with the public sector on high capital investment projects, the government should have a well-designed national sustainable development plan in place and an effective legal framework (Zhang, 2005; Li et al., 2005; 7NDP, 2017). This is because resources on the capital markets are limited and nations are competing for them. Hence, need for long-term strategic planning, technical expertise in procurement and contract negotiation, a transparent business environment and capacity building in human resources to deliver the projects following the international standards(Banda et al., 2017; Ngoma, 2015; Yescombe, 2017; United Nations, 2019). This is not easy though as in-built risks and uncertainties surround huge infrastructure projects (Loosemore, Raftery, and Higgon, 2006; Perrenoud, 2014; Xu et al., 2014; Chanetal, 2015).

Research has proved that project financing has more risks compared to traditional/corporate financing (government budgets) for infrastructure development projects (Xiong, 2017). One reason is that the leverage level of project financing is usually much higher than that of traditional financing. Furthermore, PPP infrastructure projects possess a debt ratio that is higher than 50% (Pantelias & Zhang, 2010; Xiong, 2017). For instance, energy projects usually have a debt level of 70% to 90% (Zhang, 2005). Moreover, in PPP infrastructure developments, the government transfers more risks to the private partner than those in traditional projects due to the belief that the private sector has the technology and capacity to handle them (Hwang, Zhao, & Gay, 2013; Yuan, Skibniewski, Li, & Zheng, 2010; Xiong, 2017). But if this is true, why do some projects executed through PPP fail to meet the stakeholder's expectations (England, 2018; Kumar, Fouzdar, & Duggal, 2016)? Around 70 % of PPP projects do not succeed due to the inappropriate allocation of risks between project stakeholders(G. Kumar et al., 2016). Hence, the need for a robust risk management system in place to critically identify, analyze, and mitigate the risks to secure the foundations for stable and sustainable economic growth. This is what this research attempted to achieve.

1.2.3.1 Development Agendas

The Sustainable Development Goal (SDG) number 9.1 emphasizes the need for developing countries to advance quality, highly dependable, sustainable, and buoyant infrastructure(Johnston, 2016). Johnstone (2016) further adds that the infrastructure must be able to support social-economic development and human well-being with an emphasis on reasonable equitable access for all by 2030. Improved infrastructure delivers major benefits to enhance the achievement of the Sustainable Development Goal to make cities and human settlements inclusive, safe, resilient, and sustainable (Arimah, 2017). Thus, this research contributed to the achievement of the attainment of some SDGs as once a risk management framework is developed for PPP projects, the success rate is enhanced which subsequently produces projects which meet the sustainability levels with the achievement of Value for Money for stakeholders.

Du, Wu, & Zhao(2018), explains that sustainable development is verified by qualitative changes in the economic structure, accessibility of goods and services for inhabitants which leads to a better standard of living and an increase in national income. It necessitates simultaneous consideration of the three pillars specifically the economy, society, and the environment. A stable life model concerning economic growth is associated with an even distribution of benefits (Wojewnik-Filipkowska & Węgrzyn, 2019). Countries need to align their national plans to sustainable development plans to mitigate the risks of executing projects which attract material and financial support from international cooperating partners and project financing institutions. The sustainability and risk concept must be concerned throughout the life cycle of PPP projects to enhance success and viability (Du et al., 2018).

Nevertheless, this research looked at Energy Production technically known as Energy Generation. And the specific sub-sector is the hydropower projects finalized through Public-Private Partnership in developing countries predominantly low-income countries. Some of the HPP/PPP finalized projects in developing countries include; Bujagali Hydro Power project (completed) in Uganda, Grand Inga project, situated in the Democratic Republic of Congo (DRC) (Taliotis et al.,2014) and Grand Ethiopian Renaissance Dam (GERD) in Ethiopia. Despite, Sub-Saharan Africa currently having about 126 Independent Power Projects (IPPs) present in 18 nations, Eberhard et al. (2016) reveal that there are several risks associated with these energy projects which this research bids to identify, analyze and mitigate through the development of the risk management framework.

The Zambian National Development Plan has critically mentioned several sectors that require infrastructure upgrade to reach a sustainable state by accomplishing long-term objectives outlined in the Vision 2030 of becoming a *"prosperous middle-income country by 2030"*. The named sectors include;

(a) Diversified Tourism, Transport Systems, and Infrastructure,
(b) Diversified and Export-oriented Agriculture,
(c) Energy Production and Distribution for Sustainable Development,
(d) Access to Domestic, Regional and International Markets,
(e) and Water Resources Development & Management(7NDP, 2017).

One predominant sector which has been cited in the Seventh National Development Plan launched in 2017 by the Zambian government, is the energy sector (7NDP, 2017). Zambia which relies on almost 90% of energy from hydropower has been affected due to erratic rainfall patterns that have been experienced in Southern Africa since 2015 leading to a deficit of about 1000 MW (Njanji 2015; Mfula, 2016; Reuters 2015). Some scholars have justified for PPP in the power generation sector (Chao and Saha 2016), that it is probably the easiest in which to raise private finance. This is because the supply of power is comparatively commercial, with cost-reflective end-user tariffs being less controversial for power than for services such as water and sanitation(Leigland, 2018). Chao and Saha (2016) further state that Private financing for power generation is also comparatively affordable as generation is not a natural monopoly service like water infrastructure services. Additionally, manifold infrastructure can be constructed to feed power into national grids making the generation moderately competitive.

The population of Zambia has been projected to be about 16.4 million (Zambia Central Statistical Office, 2018). Henceforth, Zambia needs to embark on the rapid uptake of both the brownfield (rehabilitation and upgrade) of old infrastructure and Greenfield (development of new infrastructure) to meet the growing demand and enhance social-economic development. Some of the HPP/PPP finalized projects in Zambia include; Itezhi Itezhi (completed) and Batoka Hydro Power (under construction).To achieve this, the Zambian government must look up for effective capital structure and project financing to undertake huge capital intensive projects amid high debt stock which as of the year 2019, stood at USD 19 billion according to the World Bank's International Debt Statistics (2019). By end of 2017(Banda-muleya & Nalishebo, 2018), the external debt in Zambia was at US$8.7 billion, whereas domestic debt, plus arrears, was pegged at K61.1 billion (Ministry of Finance, 2018). This translated into a public debt stock of 59% of GDP with external debt at 34% of GDP (Banda-muleya & Nalishebo, 2018). This is the reason PPP proves to be a solution to both developed and developing nations so that the nation does not incur more debts to strain the national budgets in the quest to develop infrastructure.

However, Johnston et al., (2017) argue that as much as there are natural causes for the energy crisis in Zambia, the crisis can be attributed to inadequate planning and power sector development. Also, huge financing input and political leadership surrounding mega infrastructure projects have been a challenge (Jones et al., 2002; Eberhard et al, 2014; The et al., 2019). Hence, this presents an opportunity to bring on board technical expertise, financing initiatives, and innovation to partner with the government to enhance the development of power generation that can subsequently contribute to sustainable human development in Zambia. This scenario presents an opportunity for PPP in energy infrastructure development. However, as earlier alluded with such massive projects, effective management of risks become so critical due to the complexity, magnitude, and value of these projects.

1.3 Energy Sector

Energy is considered a noteworthy factor for economic growth (Sadorsky, 2009). Energy plays a fundamental part in the development and sustainment of up-to-date economies because it is central to virtually all aspects of human welfare including access to necessities, agriculture, health care, employment, education, and sustainability leading to a country's success(Shakeel et al., 2016). 1.4 billion people living in developing countries do not have access to electricity but the undertaking of such projects are expensive(about USD 35 billion per year till 2030) to the governments (Partnerships et al., n.d.). It is very problematic for governments to handle the provision of finance from the national budget, technical input into the provision of public infrastructure with innovative and maintenance technique plans as there is a high chance of deviating from its core business of governance, and policy monitoring (Oyedele et al., 2016).

Energy sources are categorized as renewable and non-renewable (Ferluga, 2012; Munuo, & Teacher, 2016). A renewable natural resource refers to the energy which can be renewed or restocked in a coherent amount of time such as in decades or human life span after being used. This energy is produced from natural sources that include sun, wind, rain, tides, and vegetation in a continuous model (Bozkurt & Akif Destek, 2015; Alrikabi, 2014; Energy Education, 2016; Mehmood, 2013). Whereas a non-renewable natural resource contains exact inherent conditions that take many generations to reproduce. The exact inherent conditions have very little chance of occurring again due to limited supply and a very long regeneration period. Examples include natural gas, oil, and coal (Steinbach & Wellmer, 2010; Mehmood, 2013). Several energy projects have been undertaken under the PPP model (Sikorova & Gallop, 2015).

1.3.1 Thermal Power – Non-Renewable Energy

Generation- Thermal power refers to the technique when heat energy is converted to electric power. This is done by heating the water that subsequently turns into steam that spins a steam turbine to drive an electrical generator. However, there is a need to appreciate that the extreme dissimilarity in the design of thermal power stations is due to the different heat sources(Station, 2017; Barclays, 2015). Thermal energy sources include solar thermal electric, coal, geothermal, petroleum, and waste incineration plants (Station, 2017). Figure 1.1 shows some simple diagrams of the overview operation of thermal plants.

Vicky (2016) explains that coal is transported to the Power plant site by the use of goods train wagons, trucks or ships and then stored in the bunker house that can run a plant for 8 - 12 Hours (By et al., 2016). This is where coal is pulverized (crushed) and taken into the boiler with Primary Air (P.A) for combustion. The gases (Sulphur dioxide, carbon dioxide, nitrogen oxides, and mercury compounds) are produced after the combustion process which contains the heat that is eliminated through passing various heat exchangers and escapes through the chimney. This is the major concern about the environment(Netravati & Patil, 2015). Examples of some Thermal Power Projects finalized through PPP models are listed in Table 1.1.

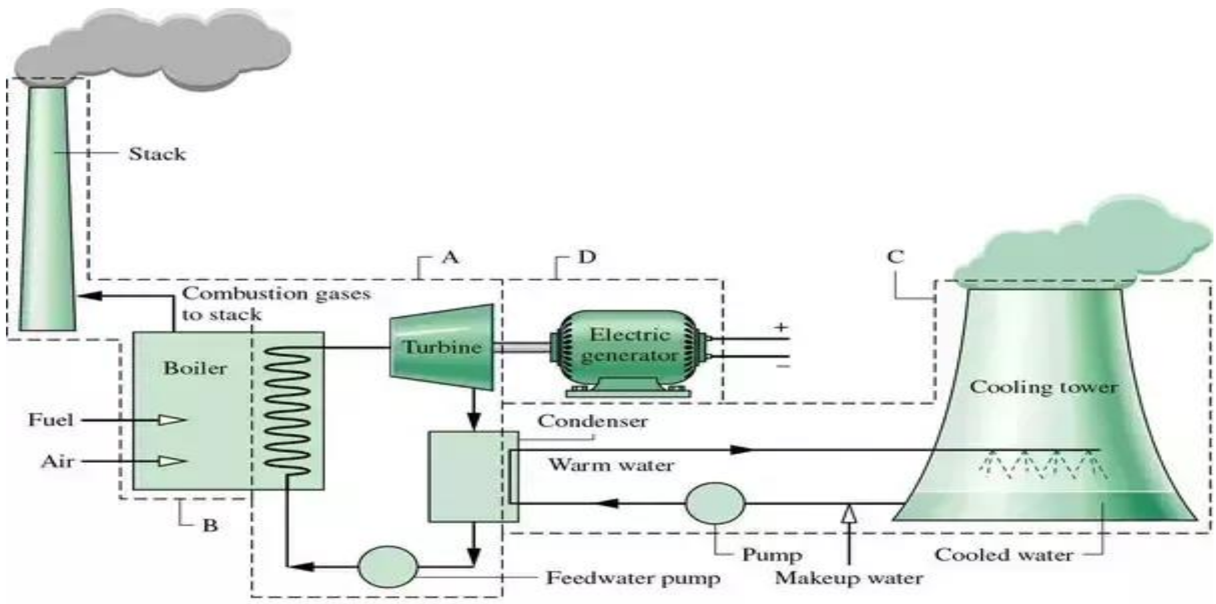


Figure 1. 1: Typical Thermal Plant Station -Source: Vicky (2016)

Table 1. 1: Proposed and Executed Thermal Projects

S/no	Project Site	Country/Cost	Project Output/Capacity	Fuel	Source
1	Tata Mundra Ultra Mega Power	India US$4.14 billion.	3800 MW	Coal	(Eurodad, 2018)
2	Thika Power Plant Project	Kenya $0.150 billion	87 MW	Heavy fuel oil (HFO)	(Aitken, 2014)

3	The Kribi Gas-fired Plant	Cameroon $0.400 billion	216MW	gas-fired power plant	(Aitken, 2014)
4	Aggreko Power Project	Mozambique $0.250 billion	107 MW	Gas-fired power plant	(Aitken, 2014)
5	Maamba Coal Plant	Zambia	150 MW	Coal	(Johnson et al., 2017)

Compiled by Author (2019)

1.3.1.2 Nuclear Energy – Non-Renewable

Nuclear power is generated from the controlled use of nuclear reactions to yield energy (Ferluga, 2012). Nuclear energy is produced when the natural radioactive decay of material, such as uranium, is accelerated to produce heat so that the water boils to produce steam to drive the turbines (Africa, n.d.; Energy Education, 2016). AFREC (2015) records that in Africa, it is only South Africa that is presently producing electricity from nuclear sources at an estimated output capacity of 14,202 GWh produced in 2013 (AFREC, 2015). Nations such as Kenya, Namibia, and Zambia including Asia are equally getting interested in nuclear energy. However, Germany (plant shutdown by 2022), Japan and many countries have decided to halt or slow down on nuclear expansion projects plan due to environmental problems (storing radioactive waste for indefinite periods)risk of sabotage, practical evidence of the nuclear disaster of Fukushima in Japan, cost of nuclear safety and increase in operating costs (WEF, 2015; Pop, n.d.).

1.3.2 Renewable Energy

Eberhard et al.,(2016) explain that between 1990 and 2013, about USD 45.6 billion was invested in new power generation but this investment was inadequate to meet Africa's growth and development aspirations. Additionally, most African governments face challenges in expanding power needs due to inadequate resources to undertake power projects. Hence, they turn to the private sector to participate in power projects. As of 2015, there have been several investments in renewable energy(solar, wind, hydro, and geothermal energy) totalling USD 9.4 billion (Thiemann & Volberding, 2017), which accounts for about 63 per cent of all energy investments via PPP projects in the World Bank database (World Bank Group,2015; Associates, 2017). Associates (2017), contrast that though renewable energy is not yet cost-competitive compared to non-renewable sources such as coal and gas, its benefits include increased energy security, reduced exposure to fuel price volatility and limited environmental impact. These benefits outlined have led many countries to consider renewable energy sources to mitigate threats to environmental degradation. The Sustainable Development Goals -2030 emphasises is on nations to have access to clean energy that must be promoted through research and technology, and the promotion of investment in energy infrastructure (Johnston, 2016).

1.3.2.1 Wind Power - Renewable Energy

Alrikabi (2014) illustrates that wind power is generated during the heating of the atmosphere by the sun that consequently produces wind on cloudy days and rainy seasons as well. The location of wind turbines is very imperative as it influences the performance of the machine. Alrikabi (2014) advises that 30 m height installation of the windmills to avoid turbulence affecting the wind flow. The optimal speed for the turbines to produce the needed output is at 22 km/hour. 50-350kw of electricity is what most wind turbines produce on average. The appropriateness of this energy includes air or water pollution-free, the wind is obtained at no cost, flexible to suit any piece of land such that even a household can install it at their expediency, no involvement of toxic or hazardous material like nuclear and it is very safe to the operators including the environment (Wadud et al., 2013). Horse Hollow Wind Energy Center in Texas is one of the largest production sites comprising 430 wind turbines spread over about 47,000 acres, with a combined capacity of about 735 megawatts (By et al., 2016). In Africa, an example is the Lake Turkana wind power plant constructed in 2017 in Kenya with a total project cost of USD 700 million with a power output capacity of 310MW (The Economist Intelligence Unit, 2016).

1.3.2.2 Geothermal Power – Renewable Energy

By et al. (2016) and Barclays (2015) explains that this is the heat mined within the earth. Drilling is done into natural fractures in basement rock or into permeable sedimentary rocks to pump out heated groundwater. Electricity is generated by the installation of dry steam plants that take the steam out of the earth to drive the turbine that subsequently rotates the generator. It is thus referred to as a renewable energy source because the heat production is continuous underground (Anna, 2006; Mehmood, 2013). The installed geothermal project for USD one million in the city of Auburn, New York in 2003 was cheaper than conventional heating and cooling system which translated into the saving of approximately USD19,000 annually in energy, operating and maintenance costs over its lifetime due to expected increases in conventional energy prices (EPA, 2014).JICA (2016) reports that in the Philippines, geothermal energy operators received presidential incentives in 1972 concerning grants and taxation to promote its infrastructural capacity which is second only to the United States.

However, (Hall, 2015a) reveals the there was a corruption risk in a geothermal project finalized through PPP between the El Salvador government and an Italian energy company Enel Green Power where the government lost an estimated amount of USD 1,824,929.05 due to poor contractual framework. Runde and Savoy (2016) elaborate that the U.S. Agency for International Development (USAID) has approximately 100 private-sector partners that have pledged 15 GW of power generation projects with over $20 billion in commitments. This includes Reykjavik Geothermal Ltd (RG), a geothermal development company that is working on several geothermal projects in Africa that includes the Corbetti Project with an expected output capacity of 500 MW in Ethiopia valued at USD 2 billion. And African Finance Corporation seeks to finance a 30 MW geothermal power project in Kenya. With such much-expected investments and current need for power generation (refer to section 1.1.3) projects in developing nations, there is a need to explore the best project financing models and well-designed robust risk management model to proactively identify the risks to avoid project failures and government losses(Hall, 2015a) like the case with El Salvador-Power project and New Berlin Airport in Germany PPP agreements.

1.3.2.3 Solar Energy – Renewable Energy

Barclays (2015) clarifies that the two main types of solar energy are solar photovoltaic (PV) and concentrating solar power (CSP). The PV power encompasses the absorption of the sun's energy using photovoltaic cells made of semiconductor material which are connected to form a solar panel. The absorbed sunlight on the cells forms an electric field across the layers of the panel to produce a direct electrical current. Thereafter, with the use of an inverter, direct current is then transformed into alternating current for both commercial and industrial use transmitted into the electricity grids. CSP absorbs sunlight heating into a receiver that in turn adjusts the sunlight into mechanical energy through turbines, forming solar thermal electricity. Mudenda et al.,(2018) reveal that solar radiation levels in Zambia are amongst the highest in the world with annual averages of about 7100 MJ/m2 which has attributed to several pilot solar energy projects being implemented across the country with the support of the public, private and cooperating partners. In 2011, the investment into solar energy in Morocco(500 megawatts Ouarzazate solar power plant through a PPP) and the United Arab Emirates reached USD 1.1 billion and USD 0.8 billion respectively (The World Bank, 2012; OECD, 2014) and in 2013 Abu Dhabi produced 100MW of solar power at its largest CSP plant situated in the desert. 155 MW Nzema solar project was planned in Ghana for USD 350million while 100MW Redstone Solar Thermal Plant at a project cost of USD 715 million was under construction in South Africa in 2018(The Economist Intelligence Unit, 2016). With the growing identification of the advantages of this renewable energy, governments worldwide are encouraging the private sector to undertake solar system projects by initiating various incentives. However, for the success of solar energy projects, an appropriate and bankable risk allocation model must be developed (Oxby, n.d.) And this is what this research is all about though it focused much on hydropower projects finalized through PPP.

1.3.3 Hydro Power Projects (HPP)

Access to dependable power remains a delinquent across sub-Saharan Africa (Ahmed 2020a). According to the Economist Intelligence Unit Report (2016), lack of electricity affected about 600 million people in Sub Saharan Africa. Countries with electricity with an access rate of above about 50% include Cameroon, Côte d'Ivoire, Gabon, Ghana, Namibia, Senegal, and South Africa with the rest having just about 20% access rate. Electricity consumption per capita outside South Africa is around 150 kilowatt-hours. If the current situation does not change, 655 million will have no access to power by 2030 (IRENA,2016). Despite, the need to increase power generation capacity, the hindering factor is the financing of these megaprojects as most countries in developing nations have limited public budgets (Eberhard et al., 2016). Therefore, this creates opportunities for private investment to move in through PPP and develop the energy sector in return to obtain some business profits and the public sector delivers the service in support of the economic growth of the nation.

A typical example of an intervention by the private sector was when the Government of Tajikistan was facing erratic energy issues, International Finance Corporation and the Aga Khan Development Network (AKDN) established a special purpose vehicle Pamir Energy to undertake a public-private partnership in an energy project. The PPP agreement was to supply hydropower to the most densely populated areas until 2027 at an infrastructure investment of USD 50 million with estimated social-economic benefits valued at USD 120 million (Sulser, 2018). Hydropower has been promoted worldwide due to its clean, cost-competitive technology, reliable, and affordable energy. Saporiti (2015), describes the characteristic of hydropower projects as stated in Table 1.2.

1.3.3.1 Characteristics of Hydro Power Projects (HPP)

This is measured as one of the most economical and pollution-free energy sources. It is referred to as hydro as water is used in the generation of electricity through the use of the gravitational force of subsiding or sinuous water (Krishan et al., 2019). High front-end costs and low operating costs (Saporiti, 2015) forms part of HPP**.** However,(Sciences, 2013) as the water is flowing, some unwanted material may be carried along posing a danger to the dams and subsequently power stations. The siltation that may be caused by the foreign material might cause flooding leading to additional level pressure on the upstream portion of the dam. This contributes to HPP project failure. Hence, Saporiti (2015) emphasizes that adequately undertaken technical feasibility is cardinal so that the specifications are enhanced to avoid failure risks of the dam.

Notwithstanding that only about 7% of hydropower has been harnessed with few projects to exploit the potential which are in the pipeline, there is enormous hydropower capacity in Africa (Sikorova & Gallop, 2015; IHA, 2019; Anandh & Vinoth, 2018). For instance, Mozambique is known as the powerhouse for the Southern Africa region which produces low-priced electricity from Cahora Bassa, dam (Hankins, 2009). Mozambique's potential for power generation has been estimated at 14,000MW of which 85% is from hydropower (Hankins, 2009). Inga hydropower project in the Democratic Republic of Congo has been cited as a major potential project in Southern Africa with the projected estimated generation capacity of 40GW of power (Karekezi, Kithyoma, & Initiative, 2003; IHA, 2019). In Zambia, there is Batoka Gorge hydropower project estimated to generate 2400MW (project stage) and Itezhi Itezhi hydro Project with a generation capacity of 120 MW(operations stage) which were finalized under PPP (Ernst and Young, 2017; Project, n.d.; Godet & Pfister, 2007). With the mentioned hydropower potential in Africa, it is envisaged that one of the factors which can influence private investment in this sector is a well-established risk management system to mitigate the inherent risks and associated challenges stated in Table 1.2.

Table 1.2 presents typical characteristics and challenges encountered by Hydro Power Projects finalized through the Public-Private Partnership model at Project Development Stage.

Table 1. 2: Typical challenges encountered by HPP/PPP at Project Development Stage

S/no	Challenges	Example/Characteristics	Remarks	Source
1	Political Interference Change of Government/ Administration. Regulatory and Policy Issues.	Frequent changes in policy/standards by the government. Delay in getting environmental and forest clearances. Shortage of Private Partners (Project Sponsors/Investors) due to non-liberal policy and monopoly of government sectors. *Example*: GERD Hydro project in Ethiopia has faced some geopolitical risks among the three countries affected by the Dam, which are Ethiopia, Sudan, and Egypt (Conniff, 2017).	Inconsistency of the policies and regulations affects projects as project developers do develop long term financing and accounting models that are easily affected by changes such as taxation, political administration, corruption and change of government ideologies. Political interference impends the private sector to bring in resources and technical expertise.	(Yang, Yang, Takahashi, Maekawa, & Parkin, 2010; Ke, Wang, & Chan, 2011; Shrestha, 2011; Tshombe & Molokwane, 2016; Eckstein, 2010; Ashok, 2011; Salman, 2013; awfic, 2016; Wheeler et al., 2016; EZEGA, 2017).
2	Lengthier development period and project financing during the feasibility stage	Unavailability of geological, seismological, and hydrological records. Delays in land acquisitions, resettlement and rehabilitation issues, and poor connectivity. *Example*: A typical example is the Batoka Hydro-Electric Scheme (BHES) Project whose feasibility has lasted more than 30 years with an estimated project cost of USD four (4) billion. And this project has	A lot of resources (time, human, and finances) are needed for feasibility studies that take so long for HPP projects. Who pays for these costs? In some cases, the studies are abandoned mid-way. The PPP Department of Zambia, for example, had to seek to amend the PPP Act to incorporate a feasibility and appraisal fund.	(Mishra et al., 2017; Klijn & Koppenjan, 2016; Charoenngam & Kurniawan, 2015)

		an estimated construction period of 10-13 years to complete(Frijns, 2016).		
3	Geological Formation and groundwork preparations.	Site-specific as its reliance is on geography, geology, and hydrology at the site. The development of HPP is characterized by some hydrology and geotechnical risks including high construction costs. High input costs in the preparations, profiling and carrying out of the geological tests to ascertain the geological formation of the ground for civil works. *Example*: Luapula and Northern Province in Zambia has abundant water bodies but not feasible to develop HPP due to the flat topography in comparison to Southern province which has hills /mountains favouring the high flow of water suitable for HPP projects.	The topographical structure of the area plays a critical role. The planning and budgeting of HPP must be comprehensive to avoid cost overrun during the project execution. The geographical characteristics possess as a risk and must be studied so that any negative eventualities are eliminated at the planning stage.	(Mishra et al., 2017; Sameer sadoon al-juboori, 2003; Kwan & Leung, 2011).
4	Enforcement of modifications to Tariff/Pricing Policy strategies,	Best value for money and lower traffics must be one of the criteria to be selected.	The private sector brings in investment as part of the PPP model, thus non-cost reflective tariffs got a huge influence on the rate of return on the investment. It also affects operations, maintenance, and capital expenditures for plant refurbishment and expansion. Hence, this risk of low tariff must be effectively allocated at Project Development Stage.	(Mishra et al., 2017;Associates, 2017;Phiri & Ziba, 2018)

5	Land and Site permits/ acquisition	Obtaining Permits and Licenses proves to be a complicated process. Other key challenges in hydropower are land acquisition, water rights including site access. Another marked encounter is poor stakeholder engagement and two-way communication throughout the entire Hydro Power Projects development process. There is uncertainty over the cost and time needed to acquire land. *Examples:* Thein Dam and Doyang, Ghatgar pumped storage plants projects in India and the Yangtze Three Gorges Project in China	Despite the great opportunities and potential of hydropower, these projects are complex and possess numerous extravagant risks. The land acquisition and permit risks cause projects delays and unexpected costs. Mostly this risk is caused by protests from the local community and political interference. Effective negotiations and engagement with the stakeholders are highly imperative.	(Mishra et al., 2017; Madan,2015 ;Jaber,2012 ;Baidya,2006;Saxena and Kuma,2010;Hillson & Hulett, 2004)
6	Detailed Engineering Works and HPP developments.	HPP has complex designs. Access roads, penstock construction, equipment procurement delivery and installation, tunnelling, grid connection are among the critical works in hydropower projects. Projects are unique and site-specific such that there are no standard designs available.	The governments need to bring on board bidders with proven high technical expertise and innovation. Knowledge transfer is cardinal and the government must ensure that this aspect is effectively negotiated and agreed upon at the procurement stage before the contract/agreement is signed.	(Bishop et al.,2015; Mishra et al., 2017; Kaunda, Kimambo, and Nielsen,2012; Sameer sadoon al-juboori, 2003).
7	Environmental, Climate Change, and Forest Clearances	Environmental and Forest clearances have become a major issue in the development of Hydropower projects. Example- Tehri Project took more than 36 years to start after the conceptualization of Project.	The key issue is innovative bids that can withstand even in the climate change scenario. For example, in Zambia for the year 2015 – 2018, the hydropower projects were highly affected by the poor rainfall. These environmental risks if properly tackled at the	(Mishra et al., 2017; K and Ramanathan,2007; Tornyie, 2015; Lumbroso, Hurford, Winpenny, & Wade, 2014; Yihdego, 2016a; Yihdego, 2016b).

		Grand Ethiopian Renaissance Dam – GERD has raised regional controversies over the construction of the dam between Ethiopia and the downstream countries such as Sudan and Egypt.	project development stage can drastically reduce problems of load shading caused by insufficient water in the dam to run the turbines. Furthermore, greenfield - hydropower projects need to be assessed within the context of comprehensive catchment-wide planning. Climate change scenarios should be incorporated into the planning and design of new hydropower schemes relative to other variables that include capital costs, operation & maintenance outlays, and return on investment.	
8	Dam Induced Resettlements and Livelihoods of Communities	HPP affects people's livelihood assets, agricultural lands, and fishing activities. Change of activities becomes a challenge as the quality and adequacy of the new resources become scarce to some households. *Example:* For Bui Dam Project in Ghana, social bonds and neighbourhood relationships were negatively affected due to poor planning resettlement in some communities.	There is a need to have a well-drawn project plan (blueprint) based on an extensive community survey and wide consultations with stakeholders. Effective feasibility studies and Project planning must be undertaken based on the environmental, economic, and social principles of the project life cycle. This enhances the sustainability of the project.	(Fynn & Abdulai, 2018);(Tornyie, 2015);(Yankson et al., 2018);(Owusu et al., 2016); Gwazani et al., 2012; Obour, Owusu, Agyeman, Ahenkan, & Madrid, 2016; Yu, Zhu, Yang, Wang & Sun, 2018)

Compiled by Author (2019)

1.3.3.2 Features of PPP- Hydro Power Projects (HPP)

Hydropower has proved a critical power supply that contributes immensely to sustainable development through the generation of naturally reasonable power (Brown & Brown, 2011; World Bank, 2009). IHA (2019), further accolades hydropower as there is a reduction in the dependence on imported fuels leading to the risk mitigation of price volatility, supply uncertainty, and foreign currency requirements. Brown & Brown (2011) explains the technicality of hydropower as a well-thought-out technique in conjunction with solar energy to drive the hydrologic cycle. The cycle process is simply explained as the sun heats water (97% water bodies), evaporation takes place in which the rising air currents conveyance water vapour to the higher atmosphere where lower temperatures condense vapour into clouds. Air currents move the clouds around the globe and ultimately, waterfalls as rainfall. It is through this process that water accumulates in various water bodies (sea, oceans, rivers). Via gravitational force that waterfalls from higher elevations creating opportunities to harness water energy. The gravitation energy in the falling of water from the clouds is turned into kinetic energy when the water begins to flow (Berga, 2016). The capacity of kinetic energy available from water flow is dependent on the following attributes, the height from which the water drops, the angle of the slope, and the volume of water per unit of time. The energy of flowing water is yoked by turbines, which are placed in the path of the water flow. The force exerted by water moving over turbine blades rotates the turbine runner; the turbine runner rotates the generator, which produces electricity (Hydroelectric Power,2011). Technical adequacy and design flexibility are imperative in the planning of this energy infrastructure (Lumbroso et al., 2014).

1.4 Zambian Hydro Power Status

Zambia is a second African country that relies mostly on hydroelectric power (Banda et al., 2018;7NDP,2017; Tembo, 2012). The Economist Intelligence Unit (2016) records that Zambian large hydropower plants are situated in the south of the country where electricity is generated and transmitted to various corridors in the country. With the rapid growth of the population and mining activities, Zambian authorities saw the need for new power generation plants (World Bank, 2018). Ernst and Young (2017), explains that 80% of Zambian electricity is generated, transmitted, and distributed by ZESCO Limited. Further, the energy sector is regulated by the Energy Regulation

Board (ERB) under the provision of the Energy Regulation Act of 2003). The Board ensures that all energy utilities in the sector are licensed, monitors levels and structures of competition, and investigates and remedy consumer complaints.

Notwithstanding the wide promotion of the finalization of HPP through PPP models, PPPs are long-term, complex projects not easy at preparing and implementing even in established and steady economies (Chou & Pramudawardhani, 2015). Despite established legal framework and legislature in developing nations, technical capacity building for Contracting Authority by World Bank, Co-operating, and Financing Institutions, several factors impede private sector investment in energy infrastructure. Hydropower projects are characterized by costly preparation, planning, and technical know-how because of higher upfront capital costs involvement and the nature of the projects. Besides, HPP involves significant environmental impacts and social dislocation which attracts hostility from local and international stakeholders (Zhang,2005; World Bank, 2014; Kabanda, 2014; Muzenda, 2009; Tah and Carr, 2000; World Bank,2018; Thomas *et al.*, 2006 and Voelker *et al*., 2008; Beckers *et al*., 2013; Hlaing *et al*., 2008; Alsulaiman, 2015).

Several risks associated with hydropower-based energy have become increasingly apparent lately. Ahmed et al. (2019) reveal that Zambia's two largest hydropower plants extremely experienced reduced output as a result of drought faced in the region. Low rainfall, low reservoir levels, almost complete dependence on hydropower, and increasing demand for energy resulted in nationwide power outages during the period between 2015 -2019 that hit Zambia's domestic and industrial electricity-dependent consumers (Ahmed et al., 2019). Large and Small Medium Enterprises in Zambia, have been highly negatively by electricity load shedding as ZESCO Limited is unable to meet the demand. This happened when there was a huge demand for power by the newly opened mines in North Western Province - First Quantum's giant Sentinel Copper Mine. At its peak capacity, the demand was about 160 MW of power that is 7% of the total installed capacity in Zambia. The construction of two new power plants (Itezhi Tezhi and Kafue Gorge Lower Hydro Power) that were supposed to meet the added demand was not completed on time. Hence, the situation was worsened with load shading and blackouts in most parts of the country. In February 2016, the reservoir at Kariba Dam fell to only 1.5 meters above the level that would necessitate a full shutdown of the plant. Although seasonal rains have slightly replenished the reservoir, it remained only 17% full as of late March 2020 compared to 49% the same month in 2014.

According to Zambezi River Authority (2020), as of March 2020, lake Kariba closed at 477.32m (12.61% usable storage) while on the same date, the lake level was much higher at 480.95m (38.94% usable storage) in 2019. Refilling the lake requires a series of vigorous rainy seasons attached to the moderation of output from the power plant (IHA,2019). However, neither of the two options has some certainty. Therefore, Zambia must rely on very expensive imported power to avoid even worse blackouts.

Furthermore, several challenges characterize the project development of hydropower projects. These include uncertainties linked with hydrology that have a significant relationship between power generation and revenues, the geological structure of the ground, environmental, social, reputational, site licenses/permits, and schedule of responsibilities(Sameer sadoon al-juboori, 2003). With the brief illustrations of the challenges encountered at the project development stage of hydropower projects, it gives impetus and justification that for the successful execution of the project, it is imperative to have a risk management framework/model which can identify, analyze and effectively allocate the risks to the appropriate party which has the capacity and techno-know how of handling the risks.

With the current situation, the Zambian government needs to come up with long-term solutions that entail investment in power generation infrastructure. Following the Ministry of Energy, there is a need to improve electrification rates in the country which stands at the rate of only 25% of the population having access to electricity, a figure that drops to a worthless 5% for rural Zambians (Dambudzo Muzenda, 2009; IHA, 2019; World Bank, 2018). Furthermore, the Zambian Master Plan targets to increase the electrification rate in rural areas from the current 3% to 51% by the year 2030 at an estimated investment cost of USD 1.1 billion (Jica/Mewd, 2009). With the growing human and industrial population in Zambia, the energy sector has the potential for the public sector to partner with the private sector to undertake energy infrastructure projects.

Table 1.3 shows hydropower installed capacity for Sub Sahara countries according to the Economic Intelligence Unit report (2016). While Table 1.4 shows the African country's hydropower installed capacity in the year 2018 as Hydropower Status Report (2018).

Table 1. 3: Hydro Installed Capacity of Sub Sahara Countries

S/no	Country	Installed Capacity of Hydro Power (<50MW) %
1	South Africa	4%
2	Kenya	14%
3	Ethiopia	30%
4	Uganda	43%
5	Zambia	85%
6	DR. Congo	92%
7	Zimbabwe	23%
8	Rwanda	90%
9	Sierra Leone	64%
10	Malawi	78%
11	Nigeria	100%
12	Mozambique	100%

Source: Climatescope (2015)

Table 1. 4: Electricity generation from hydropower source in African countries in 2018

Country	Capacity	Project Site
Angola	2,070 MW	Laúca hydropower station
Zimbabwe	300 MW	Kariba South Bank
Democratic Republic of Congo	32 MW	Mwadingusha plant
Malawi	36 MW	Nkula project
Uganda	183.2 MW	Isimba project
Cameroon	200 MW	Memve’ele project
Egypt	32 MW	New Assiut Barrage project

Source: (IHA, 2019)

The energy industry is very peculiar, hence, effective stakeholder engagements are critical(Aitken, 2014). The key stakeholders in Africa's renewable energy sector include; Project Developers, Equipment Manufacturers, Power Off-taker, World banks, multilateral development banks, Foreign Donors, and Energy Consultants. Stakeholders are individuals or organizations direct and indirect, with an interest and can contribute to the proposed project. They have, or believe they have, legitimate claims against the substantive aspects of a project (Nwangwu, 2013).

Hydropower generation projects make an indispensable contribution to the reduction of poverty, boosting shared prosperity, and improving sustainability (Johnston, 2016). Besides, water storage associated with some hydropower projects makes significant contributions to water and food security and including climate resilience (Matt, Mau, & Lauren, 2017). Hydropower is the lowest-cost source of electricity generation among several nations, with a global weighted average cost of USD 0.05 per kWh for new hydropower projects (IHA, 2019). This energy industry employs approximately 1.8 million workers worldwide, and many more in connected supply chains. Hence, the World Bank Group and many other cooperating partners offer multiple instruments to support sustainable and responsible hydropower projects of various magnitudes based on the local requirements (IRENA,2018).

According to the Atlas of Africa Energy Resources (2017), the huge potential of renewable energy must be exploited. The potential that is targeted to be achieved by 2030 is about 300 GW (Africa, 2017). The rapid development in energy infrastructure is the solution for economic growth, poverty reduction, and access to affordable energy (Africa, 2017). But the puzzle is what is the technical competence and financial capacity of the African governments to handle such high infrastructure projects and yield value for money? Thus, governments in developing nations must form a conducive investment environment for the private sector to bring onboard project financing and technical expertise to release the potential in the energy sector.

Irena (2015), opines that hydropower has a significant potential of about 1,584,670 GWh per year. As in the year 2019, 92% of potential hydropower was still unexploited. Further, Africa's hydro potential is in four main hydroelectric hubs and encompasses seven main river basins (Ibid):

a.) Western Africa on the Niger and Senegal Rivers in Guinea.
b.) Central Africa on the Congo River.
c.) Eastern Africa, the Nile River Basin development.

d.) Southern Africa, on the Orange, Limpopo and Zambezi Rivers basins.

Table 1.5 shows the Regional shares of hydro production infrastructure

Table 1. 5: Shares of Hydro Production Infrastructure

Region	% of Hydro Infrastructure
Western Africa	15%
Southern Africa	37%
Central Africa	16%
Eastern Africa	18%
Northern Africa	14%

Source: AFREC (2015)

The challenges in Sub-Saharan Africa on which Zambia belongs are by the following measures:

a.) The significance of investments needed is more than the obtainable finance, inherent risks, and up-front development costs that impede investment from the private sector.

b.) The small economy of Zambia is growing at a fast rate including its population which exacerbates by the demand for energy.

c.) Various governments in developing nations face difficulties raising project finance for much-needed investments in energy generation, transmission, and distribution including maintenance.

d.) Most energy utilities are inefficient, and their expected performance is not impressive. These challenges attribute to poor energy services and high energy prices. This subsequently negatively affects a country's competitive advantage and eventually inhibits economic growth. (The World Bank, 2013).

The above challenges cited by the World Bank (2013), gives a clear indication for the critical need for effective and proficient execution of the hydropower project through the collaboration of the public and private sector for obtaining adequate project financing, innovation, and favourable outcome. However, the model to identify, analyze, and efficiently allocate the inherent risks is what this research intends to develop for the improvement of hydropower projects' success through Public-Private partnerships.

To mitigate the energy infrastructure gap, attain some sustainable development goals and enhance social-economic growth, developing countries like Zambia, Zimbabwe, Mozambique, Malawi, Tanzania, and many more nations are engaging the private sector to take part in infrastructure development projects (Berezin et al., 2018). Hence, various governments around the world have opted to use the public-private partnership's model for design, finance, build, and operate infrastructure projects. The private sector brings on board finance and technical expertise and gets into an agreement with the public sector to execute the works which were initially intended to be done by the government. Gorodnova et al., (2018) confirm that the collaboration is cardinal as it strengthens the aspiration to accomplish specific purposes of the intended projects including the value for money.

1.5 Legal Frameworks, Policies, Institutional Capacity and Governing Principles of PPPs

Legal and regulatory frameworks for PPP need to deliver adequate protection and obligations for all stakeholders (governments, investors, lenders, etc) taking part in the PPP agreements due to the complexity of infrastructure projects and need to adapt to changes throughout the lifecycle of a PPP project (Hang, 2018; Al-Saadi & Abdou, 2016; Olele, 2016). The institutional framework must offer the support and incentives for appropriate PPP implementation, with worthwhile coordination between the different parts of the government involved (Boudot, 2014; GiZ, 2014). The institutional framework should promote proactive PPP development, adequate time for preparation of PPP projects, and strive to improve the fundamental investment climate, plus the transparency and predictability of the regulatory management (Kachapulula-Mudenda, Makashini, Malama, & Abanda, 2019; Akrm & Alwahab, 2015). Comprehensive legal expedience in PPP in Hydro Power is very vital so that the foreseeable legal requirements are met for the development of the project. Conducting comprehensive legal due diligence is quite costly at the project development stage but it is very essential. These include legal issues about land use rights, relevant legislation, tax laws, land title, and regulatory matters (Commission, 2017; World Bank, 2014).

An elegant legal and institutional framework properly supported by the political leadership attributes to the success of PPP implementation (Oyedele et al., 2016; Sarmento, 2014). The institutional framework encompasses responsibilities to be allocated to different Government entities, the project development process, the different approvals required at key decision points during the project, and how the Government supports PPP transaction preparation, procurement, and implementation. PPP policies, legislation, and regulations play a critical role in the execution of PPPs (Delmon, 2012; Commission, 2017).

The European Union has rules, laws, and policies which underpin the PPPs process. These pieces of the legislature are described as ;

(i) EU rules that give direction on government borrowing, create incentives for PPPs

(ii) European Commission policies of promoting and inspiring PPPs

(iii) procurement laws give the direction of how PPPs have to be created(Hall, 2015a).

In the African region set up, the African Development Bank Group (AfDB) has directed the PPPs approach, it has demonstrated its backing of this initiative which has increased investors' confidence in the PPPs model in Africa. This institution has been leading and advising African countries to embrace PPPs.This has been done by ensuring that the countries understand the importance and necessity of basic infrastructure essential for Africa's economic development in various sectors. The sectors include transportation, energy generation, and information and communications technologies (Ventures Africa, 2003). The other supporting financial institutions are the Development Bank of Southern Africa (DBSA).

Zimbabwe Economic Policy Analysis and Research Unit reported some inadequacies of implementing PPPs in Africa. The challenges included;

(i) The insufficient legal and regulatory framework for PPPs.

(ii) Lack of technical skills to manage PPP projects.

(iii) Unfavourable investor perception of country risk.

(iv) Africa's limited role in global trade and investment.

(v) Small market size.

(vi) Poor financial markets.

Appropriately structured PPP frameworks generate benefits to stakeholders. It enables the private sector to proficiently take up roles that were supposed to be done by the government which is supposed to concentrate on their core responsibilities that include regulation and compliance (Asian Development Bank, 2008). Hayford (2004) opined some common principles governing PPP policies and guidance as:

(i) **Market Confidence**: This looks at ensuring that the private sector has the relevant confidence in corporate governance systems surrounding the PPP projects. This is cardinal as it promotes private sector investments in projects supplementing government efforts.

(ii) **Safeguarding the Public and Stakeholders Interest:** It is very cardinal to protect the interest of the public and other stakeholders. The project becomes futile if it does not serve the intended purposes. Hence, the Project Managers in charge of negotiating and drafting PPP agreements must ensure that public interest is secured. The agreement should adequately cover competence, responsibility, impartiality, public admittance, end-user rights, sanctuary, and privacy. The general public must have the right to representation and appeal if the project is proved to be against their interest.

(iii) **Competitive Tendering and Probity**: There should be professionalism and integrity when handling the tender process and ultimately signing the agreements. Inquiries must be sent to bids either through International bidding or through National Competitive Bidding.

The importance of principles of governance and regulations in PPP is that they help in the processes, management, and protecting the concerns of the general population of the country (Olele, 2016; Robinson et al,2011). Dube and Chigumira (2010) explain that properly formulated policies, legal and institutional frameworks play a pivotal role in the success of the PPP project. This enables adequate guidance and ensuring that the investors can predict the environment with regards to PPP implementation. The policy framework on PPP guides the PPP process and makes it easy for investors to predict the environment concerning PPPs. Adequate corporate governance and legislation lead to having a well-elaborated PPP unit to which acts as the public authority to supervise the entire progression. This enables sanity and proper project management to ensure quality assurance. Though, there must be professionalism, nonpolitical interference, and corruption.

The following African countries have PPP legislation in place;

(i) Uganda -The Public-Private Partnership Act, 2015

(ii) Mauritius -PPP Act, 2004

(iii) Zambia -Public-Private Partnership Act, 2009(Which was amended in 2018)

(iv) Tanzania -Public-Private Partnership Act, 2010

(v) Kenya -The Public-Private Partnerships Act, 2013.

The South African government has well established PPP legal framework as guided by the National Treasury Regulation 16 (Bruchez, 2014; Fombad, 2013). The country has implemented an exceptional approach to renewable energy (RE) project finance and partnership development (Danielle Nel, 2018). This initiative is supported by the legal provisions consist of the South African Constitution and other pieces of legislation at the national and provincial levels. These include the Public Finance Management Act of 1999 (the PFMA; Treasury Regulation 16 of 2004; the Municipal Systems Act of 2000 (the MSA) and the Municipal Finance Management Act of 2003 (the MFMA). There is a high need for developing nations to promote transparency and accountability in the legal and regulatory framework surrounding PPP projects like the way it is in the United Kingdom, Canada, North America, and many other developed nations.

In the Zambian setup, the PPP Act was enacted in 2009 and a subsequent amendment in 2018. It has a three-stage PPP implementation process. The first stage consists of a presentation of a PPP project proposal by the Contracting Authority which is reviewed by the PPP department acting as an advisory and coordinating role. In the second stage, the project proposal is formally submitted to the PPP Technical Committee for evaluation. The role of the committee that consists of senior government officials and technical experts is to principally act as an advisory body in the PPP process (Axis, 2013). In the third stage, the technically reviewed proposal and PPP feasibility study from the previous stage are transferred to the PPP Council. Following the PPP ACT of 2009 (Zambia), this is the final authority to approve PPP project proposals. This committee is chaired by the Minister of Finance. However, there are still some critics by various stakeholders regarding the efficiency and implementation of PPP projects despite having a framework (ZDA, 2014; NAZ, 2017).

According to the PPP Act (2009), the following stipulates the functions of the PPP department in Zambia:

a. *"recommend to the Government on the use of public-private partnerships in the financing, construction, maintenance and operation of any project";*
b. *"advise Government on administrative procedures about project development and matters of policy relating to public-private partnerships";*

c. *“categories projects for purposes of this Act and prepare a project register as may be prescribed”;*
d. *“coordinate with contracting authorities in respect of any project”;*
e. *“develop technical and best practice guidelines about all aspects of public-private partnerships, standardized bidding documents, and public-private partnership agreement provisions for purposes of this Act”;*
f. *”receive and make an assessment of any proposed project submitted to it and give its recommendations to the contracting authority as to whether the project or facility:*
   (i) is affordable to a contracting authority;
   (ii) provides value for money for the Republic; and
   (iii)presents optimum transfer of technical, operational, and financial risks to the concessionaire”.

However, from the extract of the PPP Act in Zambia, it can be noticed that it has not covered the critical outlining and framework for risk identification, analysis, and allocation. The ACT simply states the “transfer of the risks”. And it has just mentioned three risks when such huge capital investment projects encounter several risks. For instance, the political, project, regulatory, corruption, economic, environmental risks are not salient in this ACT. This has justified the failure rate of some PPPs concessions which the government has been initiating.

Concerning the information presented above, it can be inferred that PPP projects require a lot of preparation and technical experts for the successful finalization of these agreements. Any misapplication or inefficiency qualifies the transaction for failure. PPP growth has been motivated by its inherent efficiency in the delivery of projects, competitive nature, high technology, and project financing from private capital. PPPs are active in more than 134 developing countries and account for about 15-20 per cent of infrastructure investment(Thiemann & Volberding, 2017; World Bank,2015a). As much as there are many successful PPP projects worldwide, there are also failed PPP's development projects (Yescombe, 2017). These are the risks in which this study attempts to identify, analyze, and allocate with the aid of a risk management framework specifically for the project development stage of s/concessions in HPP. The execution of such huge and sophisticated projects using PPP models requires a well-designed risk management model tailored to the specific project development phase (Loosemore et al.,2006). As risk management models in PPPs becoming the centre of attention by various countries, Zambia is not an exception.

On the Bujagali Hydroelectric Project in Uganda, a complaint was filed by various stakeholders with the World Bank Inspection Panel, about environmental issues, hydrological and climate change risks, involuntary resettlements, cultural and spiritual values leading to some delays in the project(Kabanda,2014; European Investment Bank, 2007; Yescombe, 2017). Equally, the 6000 MW Ethiopian Renaissance Dam (GERD) under construction sparked geopolitical tension with Egypt and Sudan based on the expectations for requirements that must be met before the completion of the dam construction (El-nashar & Elyamany, 2017). The GERD project is a pure example of political and country/regional risk (Osei-Kyei & Chan, 2017:Kodongo, 2015; Lee, Han, Quising, & Villaruel, 2018; Stritzke, 2018).

In the case of Zambia which is highly dependent on hydropower (Stritzke, 2018), however, due to hydrological and climatic variability on the entire Zambezi and Kafue River Basin where major hydro projects such as Batoka, Itezhi Tezhi, Kafue Gorge and Kariba are situated, the area has experienced extreme droughts resulting in the poor generation of power (Frijns, 2016). This attributed to load shading of power to consumers in the years 2015-2019 for not less than 10 hours every day adversely impacting production and social-economic welfare (Eberhard et al., 2008; Sichone et al., 2016; Mwila et al, 2017). Hence, weather conditions posing as a significant risk factor in hydropower projects both at construction and operational stages(Attarzadeh, 2014; Yeung, Wang, Yu, Chan, & Ke, 2010; Karekezi, Kithyoma, & Initiative, 2003). Occupation accidents (Hillson & Hulett, 2004; ZESCO, 2008; Official et al., 2019), characterize hydropower projects as evidenced by the construction of Kariba Dam which caused a large number of fatal accidents, probably more than 100 (Commission on Dams, 2000).

To achieve Value for Money on PPP project implementation amid the inherent risks stated above, an appropriate risk management model to obtain the performance outcome must be in place (Chou and Pramudawardhani 2015; Abednego and Ogunlana, 2006). The risk management framework has not been adequately articulated in the Zambian PPP legal framework (PPP Act,2008; Ngoma,2015; National Assembly of Zambia,2016; Sulser,2016; Banda *et al*., 2017). The regression model developed in PPP Infrastructure projects in Ghana asserted that predictors of project success (Osei-Kyei & Chan, 2019), were all-encompassing economic policy, project identification techniques, and appropriate risk allocation system. This is what is missing in the Zambian PPP setup.

Therefore, in contribution to the existing body of knowledge, this research explored risks inherent in the development stage of HPP/PPP. It further analyzed the probability and impact of the identified risks on the HPP/PPP objectives. The risks were then allocated to the party with the capacity to cost-effectively handle them. It also reviewed various risk frameworks/models being applied in the construction industry and subsequently designed a tailored Risk Management Framework and robust Risk Register specifically for the development stage of the HPP/PPP. The unique factors about the two designed instruments are that; there are tailored specifically for the development stage of HPP/PPP compared to other risk frameworks and registers which are generic in the construction industry.

1.6 Knowledge Gap

Studies have indicated the advantages of PPP in construction projects such as high technical expertise, innovative ideas and project efficiency (Bruchez, 2014; Berezin et al., 2018)**.** However, there are several projects which have failed due to innate risks despite various risk analysis and management tools/ practices which have been identified in the literature (Rahman et al., 2014; Hodge et al., 2018). The well-coordinated risk management approach remains the frailest link in the mega construction projects leading to poor performance. Several studies on mega construction projects have indicated that there are inherent risks in complex projects such as hydropower projects which hinders success (Hung & Wang, 2016; Mayer et al., 2019). The focus of most studies has attempted to emphasize the identification and mitigation of the risks on a generic approach of the entire project life cycle. It is also unclear if the epistemological aspects of the various stakeholders are considered during risk management. Private investment in the energy infrastructure sector reached $8.3 billion, reflecting a financial close of 25 new projects adding 3312MW to the African energy grid in 2012 (Garvin and Bosso 2008; Kwak et al., 2009; IHA, 2019). But why are Zambia and many developing nations failing to attract more private investment in power generation despite the hydropower potential cited in Luapula, Muchinga and North Western Province of Zambia (Phiri & Ziba, 2018)? It is also unclear from the existing contextual Zambian body of knowledge what risks do affect HPP/PPP and risk management practice. The

PPP legal framework and policy in Zambia has not adequately addressed the issue of risk management in a quantified practice. All the aforesaid are knowledge gaps that need to be addressed to be able to formulate a well-designed risk management framework specifically for the project development stage of HPP/PPP. The risk framework is envisaged to a well-coordinated approach with the coordinated approach in risk identification, analysis, allocation and mitigation.

1.7 Statement of the Problem

Zambia has a hydropower capacity potential of about 6,000 MW with only an installed generation capacity of only about 1,788 MW, which is just a third of its potential (Phiri & Ziba, 2018). This has led to high power demand (deficit of 810 MW as of the year 2020), exacerbated by dawdling generation projects due to lack of private investment in the last 30 years (Owen, 2016; ERB,2020). However, energy infrastructure development is restricted by tight fiscal conditions, unsustainable debt levels, and an unfavourable lagging economic environment (Deep et al.,2019; Thiemann et al., 2017). Hypothetically alternative solutions to the long-lasting inefficiencies, the innovation of technological and managerial skills, budgetary constraints, access to private capital and technical inadequacy embedded in the traditional public infrastructure delivery is a well-negotiated Public-Private Partnership (Mazher et al., 2017; Yescombe, 2017; Hwang et al., 2013).

However, HPPs are known to be site-specific that calls for huge investment coupled with long gestation periods (Kabanda, 2014; World Bank,2018; IHA, 2019). It is these characteristics that expose hydropower projects to countless risks and uncertainties that include economic, environmental, social, hydrology, geological, regulatory, political, technological, financial, climate, natural, and safety (Yeung et al.,2010; Official et al., 2019). Consequently, leads to project delays, cost overruns, insufficient energy generation and pitiable infrastructure sustainability (Danielle Nel, 2018). But how would the Zambian government attract worthwhile private investment in the hydropower generation despite the huge risks and uncertainties?

Hence, this research attempted to develop a Risk Management Framework (RMF) and Risk Register (RR) specifically for the project development stage of HPP/PPP. This is critical for the identification of the project needs, analysis of identified risks then effectively allocates the risks to the party with the wealthy influence in the Public-Private Partnership Agreements. Although there are pieces of evidence of studies on risks in PPP projects, this research looked at risks associated with the feasibility, planning and procurement stages (project development stage of HPP/PPP). It was envisaged that a well-designed risk management framework would enhance project success, attainment of Value for Money and subsequent promote private investment in HPP generation. Furthermore, it is expected to influence the core concept of sustainability (environment, economy, ethics, people, profit and planet) execution within budget, quality, safety and promotion of the win-win situation among the Project Developers, Financing Institution, Governments, Citizens and Contractor /Special Purpose Vehicle.

1.7.1 Research Problem Statement

The low progression of Public-Private Partnership in hydropower projects in Zambian is the lack of a well-formulated risk management framework that gives confidence and enhances return on investment by the private sector, despite the huge potential. Zambia has no risk management framework in PPP to address the development of the needed Hydro Power Projects.

1.8 Research Objectives

The main objective was to develop a risk management framework and risk register for the Private Public Partnership at the project development stage for Energy Infrastructure – Hydro Power Projects.

1.8.1 Specific Objectives

1. To explore the risks associated with Public-Private Partnership pre-Concessions for Hydro Power Projects at Project Development Stage (Project Feasibility, Planning, and Procurement).
2. To examine the effect of the risks and the probability of occurrences at Project Feasibility, Planning and Procurement Stage for Hydro Power Projects.
3. To develop techniques for a risk management framework and risk register suitable for Zambia Hydro Power Projects implementation through PPP including a Risk Register.

1.8.2 Research Questions

a.) What are the risks associated with Public-Private Partnership Concessions for Hydro Power Projects at Project Development Stage-Project Feasibility, Planning, and Procurement?

b.) How do the effects of the risks and the probability of occurrences affect the PPP models at Project Feasibility, Planning, and Procurement Stage?

c.) What are the techniques and inputs for the risk management framework and risk register suitable for Zambia Hydro Power Projects implementation through PPP?

1.8.3 Research Variables

This section defines, illustrates, and shows the relationship between the independent, moderating, mediating, and dependent variables used in this research (Sekaran & Bougie, 2010). The variables for this research have been defined operationally. LaFountian & Bartos, (2002) describe an operational definition as a clear, concise definition of how a variable is being measured or the observable condition.

Sekaran (2000) describes the dependent variable as something of principal interest to the investigator. On the other hand, the independent variable influences the dependent variable either positively or negatively. The moderating variables also have an equal influence on output performance. Baron & Kenny (1986) further explains that the moderating variable impacts the strength of a connection between the independent and dependent variables. It is often considered as a second independent variable in a research study.

The connection of these research variables with the objectives, tools of analysis, the scale of measurements, and philosophies including methodologies are summarized in Table 1.6. However, details are further elaborated in full in chapters two, three, and four of this research.

Table 1. 6: Operationalization of Research Variables

Specific Objectives	**Variables**	**Methodology**	**Tools of Analysis**	**Indicators**	**Measurement**	**Scale of Measurement**
Independent Variables						
a.) To explore the risks associated with Public-Private Partnership pre-concessions for Hydro Power Projects at Project Development Stage (*Project Feasibility, Planning, and Procurement).*	Identification of Risk Factors	Qualitative: Content Analysis from Literature Survey, Checklists, and Delphi Technique Philosophy: Pragmatic worldview	Binomial Test/ Chi-Square Analytical Hierarchy Framework	Risks identified Grouping of risks in a different stratum Highlighting the areas that require more attention. Provision of the basis for risk analysis and evaluation	Adequate and timely identification of the risks Risk platform ready for analysis	Nominal
b.) To examine the effect of the risks and the probability of occurrences at Project Feasibility, Planning and Procurement Stage for Hydro Power Projects.	Probability of Risk Occurrence	Qualitative: Delphi Technique and in-depth literature survey. Philosophy: Pragmatic worldview	Correlation Coefficient/ Mean Score Analysis	Estimations of risk probability. Risk matrix	Risk Ranking Significance of the risks	Ordinal
	Severity of Impact	Qualitative: Delphi Technique and in-depth literature survey Philosophy: Pragmatic worldview	Correlation Coefficient/Mean Score Analysis	Understanding the risk magnitude Estimation of the damage risk event does to the project in terms of costs. Adequate information for decision making	Estimate the level of a negative or positive impact. Significance of the risks	Ordinal

Specific Objectives	Variables	Methodology	Tools of Analysis	Indicators	Measurement	Scale of Measurement
Independent Variables						
c.) To develop techniques inputs for a risk management framework and risk register suitable for Zambia Hydro Power Projects implementation through PPP.	Technical inputs	Quantitative: In-depth literature review and Questionnaire Survey Philosophy: Pragmatic worldview	Correlation Coefficient: Kendall coefficient of concordance. Chi-Square	Technical Project Proposal Appraisal The Experience of Stakeholders Private Party Appraisal and Due diligence Institutional Capacity	High quality of the technical proposal with performance parameters included. High level of trained and experienced stakeholders. High level of adherence to specifications. High level of transparency and collaboration	Interval/Ratio
Moderating Variable						
	Legal Framework and Institutional Quality	In-depth literature review and Questionnaire Survey Philosophy: Pragmatic worldview	Correlation Coefficient: Kendall coefficient of concordance. Chi-Square	Government Guarantee The open exchange of information Regulatory and Political support Environmental quality. Domestic security Scientific and technological objectivity	Well streamlined approval system and procedures High level of corporate support and administrat support to the project Well-designed and reliable procurement model for PPP projects Independent judicial systems	Interval

Specific Objectives	Variables	Methodology	Tools of Analysis	Indicators	Measurement	Scale of Measurement
Mediating Variable						
	Risk Allocation	Delphi Technique and in-depth cross-comparative analysis of literature survey Philosophy: Pragmatic worldview	Chi-Square	Risk negotiation techniques. levels of agreement within stakeholders	Quality of public and private partner relationships Risks are being managed cost-effectively. Good project governance Value for money	Ratio
Dependent Variable						
	Successful PPP Project	In-depth literature review and Questionnaire Survey Philosophy: Pragmatic worldview	Chi-Square	Timely completion of the project Completed within budget Works executed within the technical performance and specification The satisfaction of the stakeholders	Measurable output performance standards Meeting and exceeding stakeholder's expectations The value of infrastructure and services provided. The total value cost of PPP is less than the Public Sector comparator value Low-cost project life-cycle	Nominal

Compiled by: Author (2019)

1.9 The Research Road Map

The procedure illustrates the four staged methods of the research as shown in figure 1.2.

1.9.1 Stage One

Stage one enabled the researcher to carry out an extensive and intensive literature survey on mega construction projects finalized through Public-Private Partnership. Thereafter, the research explored risks associated with the execution of Hydro Power Projects using the PPP models. At this stage, the researcher carried out consultations with various stakeholders with a profound interest in the hydropower projects. Furthermore, the study examined various literature reviews ranging from the concept of PPPs, Value for Money, Sustainability of PPP projects to existing PPP Risk Models in the Energy sectors particularly in HPP and. It also involved defining PPP Risk Models' structural setup, implementation, performance, and applicability.

1.9.2 Stage Two

After extensive and intensive studying of various material coupled with consultations with key stakeholders in the PPP and Energy sector, a checklist containing risk factors/sources and risks was developed. This was sent to the Panel of Experts in the study area established during the first stage to verify the lists, clarity, pretesting, review, and confirm applicability to the Zambian setup. The panel of Experts is composed of experts from academics, government officials, consultants, and industry. Kendall's Coefficient of Concordance was used to check the agreement among the raters (Panel of Experts). This process is known as Delphi and has been adopted as the main research design for this study (Hallowell, Gambatese, 2010b; Ameyaw et al., 2016; Chan et al., 2001, Cheung, Chan 2011).

1.9.3 Stage Three

In an event of a lot of variance regarding the responses from the respondents, the results for the first round were sent back to the experts to confirm the answers. The final checklists were then used to design and develop a questionnaire survey that was distributed to the panel of experts for responding. Quality control was then applied to the received questionnaires by using Cronbach's Alpha Model. Cronbach's Alpha measures the internal consistency of the respondents received (Cronbach, 1951; Thomas, 2002; Ho Y& Wang, 2008; Maniar, 2010). The questionnaires gathered data for subsequent statistical analysis with the aid of statistical package, mapping, and testing. For qualitative data gathering, in-depth interviews and further consultations with HPP and PPP Experts was carried out. The collected data was analyzed using Content Data Analysis. The analyzed data from both streams (quantitative and qualitative) became useful for the investigation of the various Risk Management Framework for effectiveness and establishing the relationships amongst the independent, moderating, and dependent variables. Thereafter an initial Risk Management Framework and Risk Register was developed to be applied in the HPP through PPP in Zambia. The initial framework was named Alpha-HPP/PPP. This framework was sent to various experts for testing, critiquing, assessment for applicability in Zambia.

1.9.4 Stage Four

The Alpha -HPP/PPP framework was fine-tuned taking into consideration the observations and comments from the experts. It was called Beta-HPP/PPP Framework. It was envisaged that this final framework with the developed risk register once operationalized, would provide professional guidance in the identification, analysis, and allocation of risks during the development stage of Hydro Power Projects through Public-Private Partnership in Zambia.

1.10 Scope of the Study

The study critically looked at the requirement of the Seventh National Development Plan and related it with the Sustainable Development Goals regarding Infrastructure development needs. In-depth understanding of the PPP department at the Ministry of Finance, completed and current hydropower projects in developing countries, Zambia inclusive as part of the scope. The Project Financing Institution includes; World Bank, African Development Bank, Cooperating Partners, and Donor Countries including any other financing sector were engaged through document analysis and data collection. The Private Sector, Senior Academicians, and Consultants in this area formed part of the study. The research centred on the identification of risks, analysis and allocation during the Project Development Stage (Feasibility, Planning, and Procurement).

Though this research got a lot of data from previous case studies on the identification, analysis, allocation and mitigation of various risks in multipurpose PPP projects (Schaufelberger and Wipadapisut 2003; Xenidis and Angelis, 2005; Wang et al., 2000; Bing et al., 2005; Askar and GabAllah, 2002; Zhang, 2005c), it puts more effort on specifically developing a risk management framework and risk register of Hydro Power Projects finalized through PPP. However, to get a flavorful understanding of risks at the project development stage, this research was not limited only to HPP/PPP projects but many more huge construction projects. By following this approach, a full appreciation of the effective allocation of the risks among the stakeholders could be achieved with the realization of value for money and the sustainability of the projects. In this research, the definition of stakeholders referred to project sponsors, lender institutions, private partners, government authority, consultant companies, the insurance company, contractor, operator, and Special Purpose Vehicle

1.11 The Significance of the Study

Given the prevailing macroeconomic conditions, the changes in the environment (campaign for renewable energy) and the rapid growth of the population, it is imperative that the desire to have successful projects and sustainable development is achieved through aggressively integrating the Risk Management process in agreements between the Public and the Private sector in the Energy Sector.

Once a Framework/model of Risk Management is developed, the Zambian Government through the Public-Private Partnership Department can use it by integrating it with any PPP Strategic technique plan to ensure the desired social-economic benefits including *Value for Mone*y (VFM) is realized. The Private Sector equally benefits from the two instruments developed (RMF & RR) as it has the potential to enhance the in-depth understanding of risks involved, probability of occurrence and impact, the responsible party to manage the risks, and the respective mitigation measures. The project financing institution may also use the template during the vetting of the business cases and any other bankable documents for project fining.

This study developed risk response strategies, addressing key issues from eight aspects: an impeccable legal and regulatory framework; a central coordinating and regulating PPP authority; supportive governmental authorities; institutional capacity-building; favourable economic conditions and viability; community, partner, and moral accountability; clear division of responsibilities through contracts; and effective advisory management. Finally, it is perceived that this research would contribute to the academic circles and body of knowledge.

1.12 Contribution to the knowledge

Phillips and Pugh (2005) and Zhang et al., (2018) explains that contributing to the body of knowledge refers to a unique or innovative contribution to knowledge, that is made in several ways. More detailed information is presented in Chapter 9 section 9.5, however, a brief list is as follows:

a.) *Original empirical work*: This is one of the few studies on the project management field in which a well-detailed risk management process has been elucidated and integrated on hydropower projects finalized through a public-private partnership. The study articulated well on the risk identification, analysis, and allocation. Further, developed a risk management framework and risk register specifically for the project development stage of HPP/PPP in a Zambian context. This is a major contribution to the knowledge as the hybrid framework developed based on literature survey, existing legal framework, previously developed generic risk management frameworks and guidelines from ISO 31000.

b.) *An original synthesis*: The framework developed, has the integration of all the technical inputs which were statistically tested for correlation significance. Other integration includes the incorporation of the risk management process and specifically for the project development stage (feasibility, planning and procurement). This is further achieved by assimilating the views of an expert panel and professionals during the validation of the developed framework.

c.) *New Technique in a new area*: Climate change risks have severe impacts on hydropower projects(Nsefu et al.,2020). Thus, the developed framework had incorporated the climate change resilience measures aspect. The knowledge was presented entitled; *Climate Resilience for Hydro Power Projects at Project Development Stage"* during the IEK 27TH International Conference 2020 themed 'Engineering a Post Covid 19 Future'.

d.) *Using different methodologies*: This thesis used various methodologies drawing from different strategies that included document analysis, Delphi panel of experts' technique, semi-structured interviews, questionnaire survey and document analysis as discussed in Chapter five.

1.13 Thesis Chapters Outline

Chapter One: This chapter provides an abridgement of the purpose of the research. It provides a comprehensive review of the Public-Private Partnership, understanding of risks, and the importance of risk management. It further sets the current status of the energy sector around the world and the hydropower projects. It gives brief statistics regarding the consumption rate, investment costs, and future demands. The knowledge gap, statement of the problem, research problem statement and the significance of the study including the knowledge contribution were stated. Also, the main objective, research questions, and objectives have been presented in chapter one including a brief analysis of the research variables. And finally, a flow chart of the methodology to be employed in the research is provided.

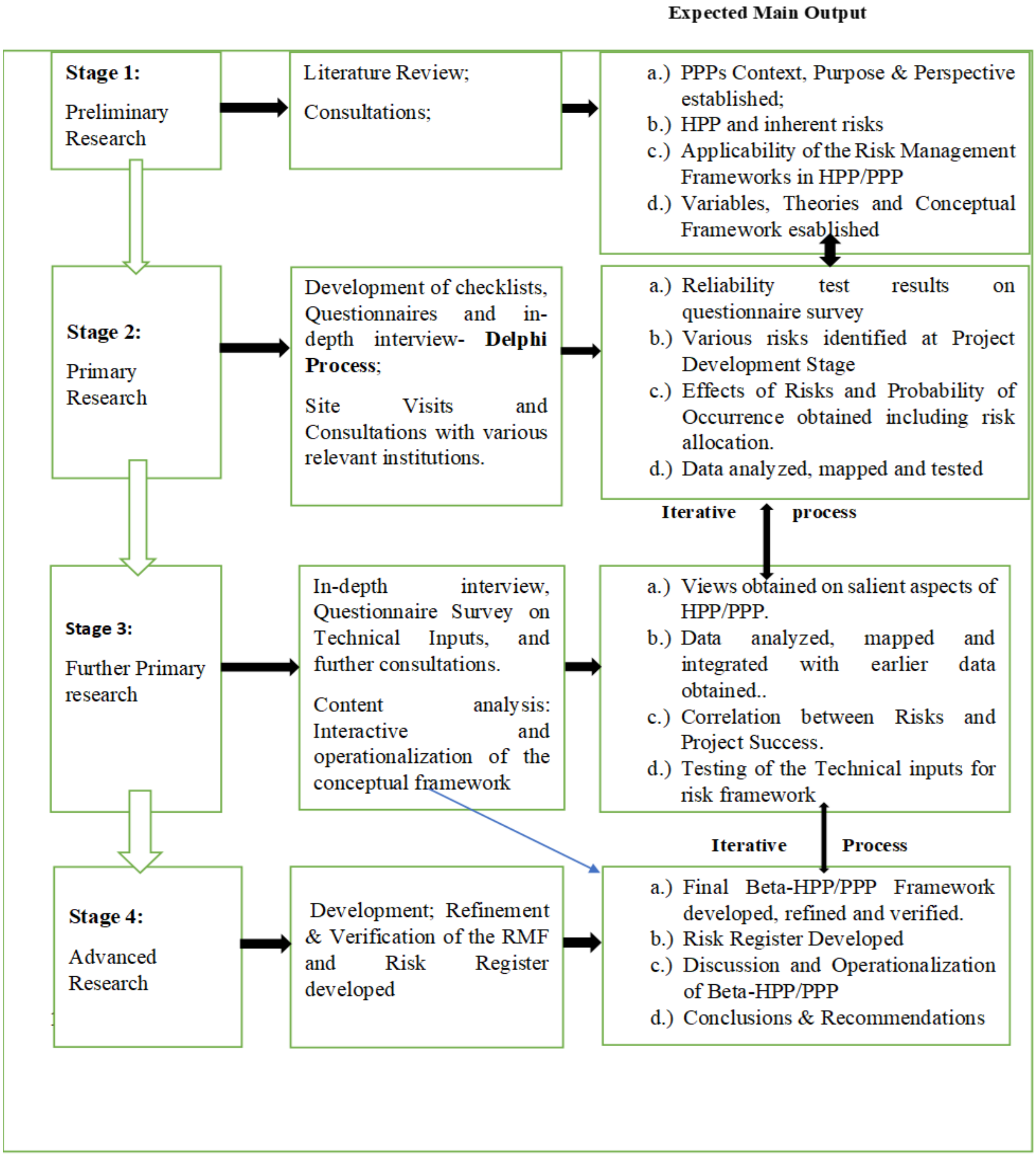
Chapter Two – Literature Review (Part A): Research objectives were used in guiding the direction of the chapter. This chapter explored the risks associated with HPP projects with the citing of various construction projects around the world. Then the chapter also looked at the probability of the risks occurring and their effects on the project objectives. Afterwards, several existing risk management frameworks were analyzed and assessed for their performance on previously executed projects. Finally, a Research knowledge Gap was established from the highly extensive literature survey.

Chapter Three – Literature Review (Part B): Part B of the literature review explored the deep illustration of the operationalization of PPP concepts and their importance in developing nations. Project Finance of HPP was fully analyzed and the role played by various financing institutions such as World Bank, International Financing Corporations including many other cooperating partners.

Chapter Four: The theories of the research are elaborated and clearly, linked to the Project Development Stage of HPP using the PPP model. The Conceptual framework is developed by showing the linkage of the Independent, Moderating, and Dependent variables.

Chapter Five: The research approach and design have been clearly explained in this chapter. The philosophical underpinning of the study which was a pragmatic overview is illustrated in chapter three. The Delphi method which was the main research design adopted explained how it operates. Data analysis tools, validity and reliability tools, and ethical consideration were explained in this chapter.

Figure 1. 2: Proposed Research Methodology- Source (Author 2021).



Chapter Six: The collected qualitative (in-depth interview, literature survey) and quantitative data (questionnaire survey) were analyzed using the various statistical packages. The Alpha-HPP/PPP Framework and Risk Register was then developed. The developed initial framework was sent to the experts in the energy sector for their inputs. This was done to refine and verify it to develop the final Beta -HPP/PPP Model.

Chapter Seven: This discussed the findings and operationalization of the collected data.

Chapter Eight: The evaluation and validation of the Alpha –HPP/PPP Framework and Risk Register are done and the result from the analysis was presented. Thereafter, a final Beta – HPP/PPP was presented.

Chapter Nine: The conclusion of each research question and recommendations were presented in this chapter. Limitations and challenges encountered during the entire research were presented including recommendations for future research was done in this chapter.

1.14 Chapter Summary

Energy Infrastructure in specific Hydro Power investment encompasses contracts that are by nature complex and of long duration. The investments to proceed must ensure financial sustainability while meeting user needs and social objectives. There are even more challenges in huge infrastructure development projects as foreign investors are involved. Furthermore, private infrastructure investment is increasingly being alert due to the current global economic crisis, capital markets, political, regulatory, country social, and environmental risks. As established in the sections provided in this chapter that risks are inherent in every project and occurs at any stage of the project life cycle.

This chapter looked at the general introduction and the background of the study. It also presented the justification for the study and the questions that are being researched. The chapter has elaborated on the various benefits and risks associated with hydropower projects.

The next chapter discusses the literature review at the international, regional, and national levels on huge construction projects. It also extensively discusses the PPP concepts, Hydro Power Projects, and establishes the knowledge gap.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

With the guild of the research objectives, part A of the literature review explored the numerous risks related to HPP/PPP projects (Project Feasibility, Planning, and Procurement) from the global perceptive including their impact on the projects and economic state of the host nations. Several existing risk management identification, analysis techniques and models/frameworks were analyzed including their performance on previously executed projects. Thereafter, the research knowledge gap was established on each research objective in terms of methodology, conclusions, and recommendations from the extensive literature survey in tabular format.

2.2. Risks associated with Public-Private Partnership in Hydro Power Projects

Risk is known as "a measure of the probability and consequence of not achieving a defined project goal" (Kerzner, 2006). Al-Bahar and Crandall (1990) define risk as "the exposure to the chance of occurrences of events adversely or favourably affecting the project objectives as a consequence of *uncertainty*." For this study, the risk is distinct as an uncertain experience or condition that if it happens, has a positive or negative consequence on a project's objective. A well–designed risk framework/model has been recommended for the provision of a structured process that allows for risk to be identified, understood and managed proactively by minimizing threats and maximizing opportunities(Ponis & Ntalla, 2016; Suđić, Ćirović, & Mitrović, 2017; Yehoue, Ruhashyankiko, & Hammami, 2010).

The risks are found in every project, thus, the result can be negative or positive to the overall project both in cost and customer satisfaction. Meanwhile, there has been no consistent usage of the exact definition of risk. Many scholars have brought about different definitions. Perrenoud (2014) claims that there are more negative definitions than the positive and opportunities presented by risks. Project risks are known to be of complex marvel associated with finances, physical, cultural and social dimensions with the potential to affect organization objectives (Darvish et al., 2006). Risk Management is thus known as a formal process that systematically and technically carries out the identification, assessment, planning, and management of risks (Merna & Al-Thani, 2008).

The PPP hydropower projects are complex, long term and highly technical, not all projects have been successful even in situations that have well established legal frameworks and steady economies (Chou and Pramudawardhani 2015; Zhang,2005; World Bank, 2014; Kabanda, 2014; Muzenda, 2009; Tah and Carr, 2000; World Bank,2018; Thomas et al., 2006 and Voelker et al., 2008; Beckers et al., 2013; Hlaing et al., 2008; Alsulaiman, 2015). There are several risks in mega construction projects on which the hydropower projects are categorized in. Thus, there is a need to devise a strategic technique in achieving project purposes within the principles of time, cost, quality, safety, and environmental sustainability. Risk management in construction projects is a prime process (Braeckman, 2008; Mccann & Busadm, 2014; Devan, n.d.)and the process only realizes value for money and sustainability once implemented systematically (Nelms, 2012). The risk management process entails; risk identification, risk analysis, risk mitigation, and monitoring (Dikmen, Birgonul, Anac, Tah, & Aouad, 2008; Mills 2001; Nelms, 2012). This section explores the identification process and techniques of risks inherent with hydropower projects at the project development stage.

Legislation in Vietnamese (Nguyen, 2017), has a requirement that the contents of project preparation documentation include risk identification and the feasibility study report analyses risks including responsibilities of the parties. Inadequate risk identification contributes highly to project failures (Zack et al., 2009). The cost of managing risks is a direct function of the risk identification accuracy and evaluation process (Kodongo, 2015). Due to the involvement of PPP projects, this process must be undertaken at the project development stage so that it caters to the rest of the project cycle (Desgrées du Lou, 2012). Fischer (2010), adds that the uniqueness of the PPP projects is what makes the identification techniques not to be standardized but depends on the expert's knowledge characterized by the notion of perceptions and subjective probabilities. The section below elucidates extensively on the risk management process; identification, analysis and mitigation.

2.3 Risk Identification Methods

Several methods are used in identifying risks on a construction project (Charel & Galarreta, 2007). The methods include; brainstorming (Balkans, 2018), checklists (Sharma & Kar, 2018), flow charts (Yakubu & A. Anigbogu, 2016a), case studies (Darvish et al., 2006), SWOT analysis (Akrm

& Alwahab, 2015), Delphi Techniques (Sharma & Kar, 2018), Survey investigations and interviews (Haseeb et al., 2014). Other identification techniques include; documentation analysis (Shrestha, 2015), Cause-and-Effect (Walker & Pryke, 2008), and Scenario assumptions Analysis (The World Bank, 2017; Ke, Wang, & Chan, 2012).

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Identification of the risks is a crucial component because if the process is not carried out well, some potential risks can be adverse once occurred (Dikmen et al., 2008). This is indicated by Wang, Dulaimi & Aguria (2004) that the risk analysis process is only carried out only if there has been a good identification of potential risks. Since HPP/PPP is complex (Carbonara et al., 2015), planning, scheduling, organizing, controlling, and monitoring of these projects to be more efficient and effective, risks must be known through the risk identification process (Effah Ameyaw & Chan, 2013). This is anchored by (Chaaya, 2018), who states that Australia's failed PPP infrastructure projects was associated with unsuitable risk identification and analysis techniques. In agreement with N. Carbonara et al. (2015), Nkhungulu(2014) enlightens that risk allocation must be carried out at the contract negotiation stage and risk identification should be done well before the PPP stakeholders sign the agreement/contract. Berger (2006), confirms that several risks can be minimized or eliminated if adequate identification is conducted thoroughly during feasibility studies and planning stage. This is in accordance with this research as it looks at risks associated with HPP/PPP at feasibility, planning and procurement stage (project development stage). Table 2.1 illustrates some of the identification techniques compiled by this research from various literature data found. These techniques are being used on various PPP projects:

Table 2. 1: Risk Identification Techniques

Identification Technique	Operation	Project	Remarks / Critic of the Technique	Author
SWOT Analysis- Risk identification from corporate expertise in the relevant project	The use of experts with the relevant skills in the analysis of the strength, weaknesses, Opportunities, and Threats on the project objectives. During the process, the positive and negative risks are identified. Databases are intensively used as well.	Hydropower development in Nepal-China; Power generation in Pakistan	PPP Energy Infrastructure projects are complex, hence, for adequate technical planning, additional techniques must be used. This technique also lacks hierarchy which is cardinal in risk management.	(Charel & Galarreta, 2007; Acharya et al., 2013o; Shakeel et al., 2016; Ke et al., 2012)
Survey Investigation- Risk identification from a security standpoint	This is done by analyzing the causes of previous events, incidents, and accidents on similar projects. This leads to formulating proper standards and procedures to avoid similar predicaments.	Hydropower projects in Asia and Western Europe; PPP projects in the UK, China, and India	Despite surveys having a high level of ability to represent a bigger population, cheaper, excellent Statistical Significance, they are not suitable for contentious subjects, inflexibility in design and some questions are so generic rendering unseemliness to the study.	(Lako et al., 2003; Charel & Galarreta, 2007; Anh Nguyen et al., 2017)
Risk identification from brainstorming	Brainstorming sessions are conducted when the problem encountered is indistinct as the interaction among different stakeholder's countenances for a more comprehensive identification.	PPP in Iraq Infrastructure Projects Successfully; PPP in Hong Kong; Public-Private Partnerships in Kenya's Transport Sector	It produces good results and promotes teamwork, but, it is time-consuming, team thinking overrides independent intellectual, too many voices blocking the production and also it harbours the aspect of going in circles.	(Ke et al., 2012;Sarvari et al., 2019;Akrm & Alwahab, 2015;Cheung & Chan, 2011;Nasieku, 2016)

Identification Technique	Operation	Project	Remarks / Critic of the Technique	Author
Flow charts - Risk identification from data flow	Used mostly in risks related to supply chain projects and logistics. With the use of flow charts, the flow of data, the supply of material, machinery movement, and end products, risks are identified in this process. Anomalies discovered with data flow analysis, such as glitches in material or machinery specifications.	Privately Financed Market Projects in Nigeria; Queensland engineering construction industry,	Flowcharts present virtuous documentation, clearly communicating the system's logic for the project enabling the identification of risks effective. However, the logic gets complicated on mega construction projects resulting in more time and resources to comprehend to identify the risks. Modification is a challenge as it requires to re-do the drawings.	(Awodele, 2012;Lyons & Skitmore, 2004;Yakubu & A. Anigbogu, 2016a)
Interviews - Risk identification from interviews and polls	Polls and interviews are used for risk identification through interacting with the stakeholders and getting their opinion and perception about the projects.	Solid Waste Management PPP Projects in India; Cabora Bassa Dam in Mozambique;	Interviews are useful in gaining a deeper insight into the situation and seeking quality detailed information. However, time demanding, costly and more resources are needed for the creation of the interview guild, preparation of the room, transcribing, and coding arrangements.	(Mccann & Busadm, 2014;Charel & Galarreta, 2007;Berezin et al., 2018;M. Shrestha, 2011;Zou et al., 2008;Isaacman & Isaacman, 2016)
Delphi Method - Risk identification from expert / consultation expert consultation	Experts in the particular project are hired to technically identify the inherent risks and make the relevant recommendation of the process including mitigation measures. It brings on board inter-discipline experts to guide the risk management of the project.	Malaysian public-private partnerships; Construction industry in the United Kingdom; Transportation project in Thailand; Australian Public-Private Partnership Infrastructure Projects	It is a highly versatile technique (used in many disciplines), has legitimacy and suitability for solving exceedingly complex problems. It also has some anonymity inheritance. However, Delphi takes a longer time than other techniques and is arduous for both experts and researchers. Due to too many rounds, the probability of dropouts is high. Affecting the process. Finally, since the sample size is small, it proves very	(Tang et al., 2018; Nelms, 2012; Anvuur & Kumaraswamy, 2006; Attarzadeh, 2014; Rajput, 2017; Sarvari et al., 2019; Kibler, K., D. Tullos, B. Tilt, A. Wolf, D. Magee, E. Foster-Moore, 2012; Shang Zhang et al., 2016; Chaaya, 2018; Osei-Kyei and Chan,2017; Fink-Hafner et al., 2019)

			difficult to infer the results of a large population.	
Identification Technique	**Operation**	**Project**	**Remarks / Critic of the Technique**	**Author**
Checklist- Risk identification tool	This technique is very fast and efficient. It is mostly used on the procurement of routine nature and standard well-known procedures.	Itezhi-Tezhi Hydropower Project; Kai Tak cruise terminal project in Hong Kong; Iraq Infrastructure Projects	This technique is used to increase accountability levels on the project site and identifies a great number of risk exposures. It is also used as a training tool to educate project team members on risk management. Nevertheless, it has a probability of creating a false sense of security if not done appropriately. Furthermore, the construction projects are so busy with competing tasks, thus, the probability of completing the checklists just for the sake of handing it over. Also, the long checklist can prove to be fatigue for the respondents.	(Goh et al. 2013; Thiemann, M., & Volberding, 2017;Dunn, 2017;Project, n.d.;Aldrete et al., 2010; Ling, n.d.;Farquharson et al., 2011;Akrm & Alwahab, 2015)

Source: Compiled by the Author (2019)

2.4 Risks identified at pre-Concessions for Hydro Power Projects at Project Development Stage

As earlier stated in the sections above, risks can only be analyzed once there have been accurately identified. Thus, this sub-section explains the risks which are typically associated with hydropower projects at the project development stage (feasibility, planning, and procurement). The source of the risks and risk factors have been explained as discovered by various scholars and experts in project management. Some risks due to their inherent characteristics feature on all the sub-components of the project development stage.

2.4.1 Project Feasibility

Any mega PPP project is expected to be appropriately identified by eloquently understanding its needs, operatives, market demand, and financing (Olele, 2003). It is a critical stage as many validity and reliability tests are carried out to ascertain the variability of the projects. A critical illustration of the importance of the feasibility studies is the case of the 1300 MW -Mphanda Nkuwa hydro project in Mozambique (Hankins, 2009). The feasibility studies revealed that the project had no direct short term benefits due to the social and environmental risks that needed to be effectively mitigated during the project execution for the rural population (Hankins, 2009). Team (2015), states that in Zambia when there was a need to rehabilitate the Kariba Dam, feasibility was carried out to confirm the possibility of using a dry-dock instead of a slipway, but due to the reservoir level fluctuation range, this solution was found not feasible. Just in this Zambian case, the vitality of feasibility can be depicted because if it was not carried out, the reservoir level fluctuation range caused by the environmental risk could not have been identified. It is known that at the feasibility stage of dam construction, challenges such as environmental, technical, and social-economic are inherent in most projects which must be comprehensively identified and analyzed (African Development Bank, 2014).

Table 2.2 illustrates the risks associated with the feasibility stage of hydropower projects and any mega construction projects of the same magnitude.

Table 2. 2: Significant Risks Associated with HPP/PPP and other related Mega PPP Projects at the feasibility stage

Project Component	**Risk Factor**	**Risk descriptions**	**Affected Project**	**Sources**
	Environmental Risk	Mega construction of projects such as hydropower dams possesses some negative effects on the environment, economy, and surrounding communities.	Belo Monte hydropower project; Lower Shobonsiri Project in North East and Narmada hydropower project in India; Akosombo hydro project in Ghana; Bujagali Hydropower Public-Private Partnership Project.	(Kakati & Dean, 2016;Kabanda ,2014;(Minnie et al., 2011;Kachapulula-Mudenda et al., 2019;Osei-Kyei & Chan, 2017b;Yehoue et al., 2010;L. Zhang et al., 2019; Brown et al., 2009).
	Project approvals and permits.	Intricate processes are involved during the approval of projects and the obtaining of permits to commence the works. This causes delays to the project and affects the funding projections.	PPP-transportation projects in Vietnam; Water supply projects in Ghana;	(And & Region, 2009;Likhitruangsilp et al., 2017;Nelms, 2012;Effah Ameyaw & Chan, 2013)
	Land acquisition and compensation problems	Acquisition of the land being characterized by bureaucracy, high costs, unnecessary delays affecting the commencement of construction.	Yangtze Three Gorges Project –China; Melbourne City Link project; Taipei underground rail (NT$28.9); PPP transportation projects in Vietnam	(J. Li & Zou, 2014;Hillson & Hulett, 2004;Cerimagic et al., 2015;Olele, 2016;L. Tshombe & Molokwane, 2016;Karim, 1991);
	Public opposition/ hostility	Poor stakeholder engagement usually leads the public to oppose the projects due to unknown apprehensive. This causes project delays, insecurity, costs, and vandalism of the project equipment/machinery.	Three Gorges Project in China; Lekki Road PPP Project in Nigeria; Thiba Dam In Kirinyaga County, Kenya	(Minnie et al., 2011;Tolani, 2013a;Hodge et al., 2010;Ndirangu, 2014;Hall, 2015a;J. Li & Zou, 2014;B. Li et al., 2005;Bing et al., 2005)
Feasibility Stage	Market competition (uniqueness), Level of demand for project and cost overrun.	The project brings in its competition with the current similar products or services. The public partner in a PPP agreement is allocated the risk of marketing and	Sardar Sarovar hydro Dam in India; La Grande hydro project in Canada; Three Gorges hydro project in China; The Fazakerley Prison (UK); Chinese water PPP	(Bel et al., 2017; (Matt et al., 2017); (Wilhelm, 2009); (Olele, 2016); (Jordan-Tank & Garcia, 2016); (Ling, n.d.); (Ernest E. Ameyaw et al., 2014);

		demand through such as Power Purchase Agreements in the energy sector. Cost overrun of the hydropower projects.	projects; The Kafue Gorge hydroelectric power plant, Itezhi Tezhi hydro Project and Batoka hydro project in Zambia;	(Sobhiyah et al., 2009); (Godet & Pfister, 2007b); (Brown et al., 2009)
	Political Interference	Political violence, Government interference, corruption, the intervention of strategic decisions by the government, and biased stakeholder engagement. Other examples include a geopolitical situation such as the GERD project in Ethiopia.	West Kowloon Cultural District project - Hong Kong; PPP infrastructure projects in Pakistan; Chicago Skyway project, Port of Miami Tunnel (POMT), and parking project in the USA.	(Sobhiyah et al., 2009); (Brown et al., 2009); Roman, 2015; Mazher et al., 2017; M. Shrestha, 2011; N. Carbonara et al., 2015; Interactive & Project, 2015)
	The poor public decision-making process	Unavailability of standardized procedures, the process is characterized by bureaucracy, poor institution capacity, and unable to identify information asymmetry created by the private sector.	PPP highway projects in China; Inkosi Albert Luthuli Central Hospital-South Africa; PPP in Iraq Infrastructure Projects.	(Yehoue et al., 2010; Farquharson et al., 2011; Haglund, 2017; Yu, 2017; Ernest E. Ameyaw et al., 2014; Ke et al., 2012; Akrm & Alwahab, 2015)

Compiled by Author (2019)

Table 2.2 presents some prominent risks encountered at the feasibility stage of mega construction projects of which hydro projects are classified among them. However, the list is endless, thus only some of the most significant risks have been presented in the table. Without risks identification and analysis, then the entire development is not worth it (Sarvari et al., 2019; Hertz and Thomas 1983). Though there have been some attempts to cope with risks, including ignoring their existence, however, there comes a point the project fall short of the mark in one way or another. In some cases, risk identification leads to project cancellation or major modifications during the initial planning stage. If risks are identified and managed early on, their negative impacts on the outcome of the project are minimized because the cost to implement changes in the project is also lower at this stage (Maqbool and Rashid 2017). Figure 2.1 depicts the influence curve, which demonstrates the theoretical capability of risk identification to influence the project schedule, quality, and cost at different stages of the project (Sarvari et al., 2019).

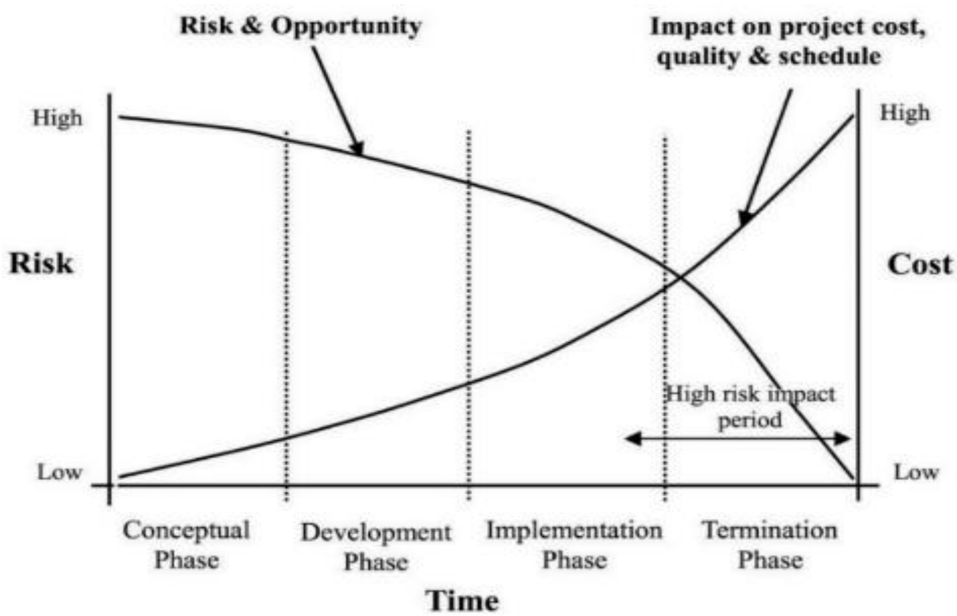

Figure 2. 1: Influence Curve (Source: Hlaing et al. 2008).

2.4.2 Project Planning

Table 2.3 presents the risks inherent in the planning component of the mega PPP construction projects. After, the feasibility studies, the next stage is planning before the procurement comes in. Appropriate planning provides more accurate information that becomes so useful and bears a positive significant impact on project deliverability such as attainment of value for money and customer satisfaction (Yitmen et al., 2012), Akrm & Alwahab, 2015; Khan et al.,2008). And in linking the planning to sustainability development (Wojewnik-Filipkowska & Węgrzyn, 2019), there needs to embrace of effective planning as it builds on the strategy of expertise in the way resources are applied on the project in improving the existing societies without waning the situation for future generations. Key stakeholders must be involved in the three phases(initial screening, secondary screening and due diligence) of planning to enhance PPP success (Sameer sadoon al-juboori, 2003). The PPP achievement in some developing countries though executed in difficult environments and conditions is largely attributed to careful planning, committed and flexible private partners, and good corporate governance on the part of governments (Sulser, 2018). Thus, Table 2.3 strives to identify several risks associated with the planning stage of the PPP/HPP projects and many other mega construction projects.

Table 2. 3: Significant Risks Associated with PPP/HPP at the planning stage

Project Component	Risk Factor	Risk descriptions	Affected Project	Sources
Planning Stage	Hydrology	This postures among the uppermost risk in hydropower projects. The generation of power and projection of revenue is determined by the hydrological status of the catchment area. Thus, during planning, information on the hydrology status is so prominent. However, this risk is not controlled by a simulation. Due to climate change, appropriate comprehension of future hydrological characteristics is a challenge.	Batoka Gorge hydropower site on the Zambezi River – Zambia/Zimbabwe; Jinja-Nile hydropower complex, Nalubaale (formerly Owen Falls) and Kiira-Uganda;	(Sameer sadoon al-juboori, 2003; Lumbroso et al., 2014; Harrison et al., 2003; Zarfl et al., 2014; Kibler, K., D. Tullos, B. Tilt, A. Wolf, D. Magee, E. Foster-Moore, 2012; Eberhard et al., 2016; Saporiti, 2015; Department for International Development, 2009; Authority, 2017; Liang & Wang, 2019; Lee et al., 2018b)
	Environmental and Forest Clearances	Environmental and forest clearances are a major issue in the development of hydropower projects regarding concerns on deforestation, submergence, monuments, seismicity, ecology, flora, fauna, wildlife protection, and catchment area treatment. This has led financing institutions to request a well-conducted environmental impact and social assessment of the project by experienced Consultants and Transaction advisors to review details of the feasibility study before the procurement stage. The financial closure is only attained once the cost-benefit analysis proves to be on the positive side. Hydropower projects should not be executed at the expense of the environment and livelihoods.	Arunachal Pradesh-India; North Luzon Expressway Project-Philippines, Tignes-France; Grand Inga - Hydropower development in Congo	(B. Mishra et al., 2017;Sameer sadoon al-juboori, 2003;Anandh & Vinoth, 2018;C. Kumar, 2018;(Dean, 2014;Boyé & Vivo, 2016;Ali et al., 2017;Taliotis et al., 2014;Andrade & Loiola, 2013;Lee et al., 2018b;Berezin et al., 2018).
	Financial Constraints /	Hydropower projects involve extremely high costs, since, majority of these projects are located in remote locations making connectivity a delinquent, colossal costs are incurred in developing the road network,	Mpanta Solar Mini-Grid Project in Samfya District, Luapula	(B. D. Mishra, 2016;Ngoma et al., 2014;Johnson et al., 2017;Md Lasa et al., 2018;

	Funding Approval	housing infrastructure, payment of royalties, and any other related works. Thus, the project must be viable to attract debt and equity from various financing circles. This is a critical issue in the Zambian setup, as the legal framework is silent on the financial measures to address such constraints and risks. Despite, the act providing clauses prescribing the criteria for evaluating financial and commercial proposals, it lacks directives on appropriate PPP financing structures to ensure return on investments and user affordability of possible charges.	Province-Zambia; Kafue Gorge Lower-Zambia.	Burger et al., 2009; (Menendez, 1998;Muleya and Zulu, 2009;Berezin et al., 2018;Likhitruangsilp et al., 2017).
	Permitting / licensing	This is a complex process that has the potential for project delays and unnecessary costs due to most government bureaucratic tendencies exhibited during approvals. The proposed risk mitigation includes acquaintance with specific guidelines stated, effective engagement with the relevant government departments, and traditional community leadership including collaboration with experienced local partners or consultants.	PPP projects - Vietnam; PPP in India; (PPP) risks in managing water supply projects in Ghana.	(Sameer sadoon al-juboori, 2003; Minnie et al., 2011; European Investment Bank, 2011; Sulser, 2018; Karim, 1991; Bing et al., 2005; Effah Ameyaw & Chan, 2013; Madiye Luxmore Chikuku Tauyanashe, 2013; Bing et al., 2005)
	Design / Technical risk	Hydropower projects have complex designs such that no standard designs are used due to the uniqueness of geotechnical formation. Therefore, there is a need for long term planning purposes. It calls for more design involvement, geotechnical review effort, and the manufacturer of critical equipment such as Turbines at the design stage to enhance project performance. The risk is prone where untested technology and unproven detailed engineering design work is applied without due technical diligence. This risk if not mitigated induces technical challenges at all stages of the project. This risk is borne by the private party and it is in their scope to mitigate it.	Kariba North and Victoria Falls had been rehabilitated to design condition levels-Zambia; Kafue Gorge and Kariba North Bank required urgent interventions; Mexican Toll Road program of (1989-1994); Cuernavaca- Acapulco toll road.	(B. Mishra et al., 2017;Likhitruangsilp et al., 2017;Bing et al., 2005; Andrade & Loiola, 2013;Benes & Stary, 2009;Liang & Wang, 2019;Lee et al., 2018b;Nzali Banda et al., 2017;Ruster, 1997;Berezin et al., 2018;Sarmento, 2014).

	Public Awareness	This is necessitated by the negative perception in public regarding the safety and environmental damage due to hydropower projects and related activities. There is a need for adequate public engagement and commitment during the project planning stage so that the issue of sustainability (refer to 2.2.3) is adequately incorporated into the project.	Uttarakhand-hydropower development in India	(B. Mishra et al., 2017; Almarri & Blackwell, 2014)
	Cost Estimating / Cost overruns and schedule delays	Complexity nature coupled with high technical inputs of the hydropower projects leads to a lot of cost overruns and project delays. Civil works constitute almost 50% of the total project costs posing the risk of cost overruns if proper planning is not done. Another critical component that requires detailed attention during planning is the supply, delivery, and installation of electrical and mechanical equipment. Other costs that must be properly defined are resettlement costs, continuous environmental analysis, and development of recreation amenities including compensation on, historical/traditional facets.	Arena Fonte Nova Stadium- Brazil; The Lekki Toll Road Concession-Nigeria; Yen Lenh Bridge BOT project- Vietnam; Con River hydropower station in Vietnam; Bujagali project in Uganda; The Nam Theun 2 project in the Lao People's Democratic Republic (Lao PDR) and the Arun III project in Nepal.	(IRENA WORKING PAPER, 2012; Brown et al., 2009; Zack et al., 2009; Hovy, 2015; Afunanya et al., 2016; Oxby, n.d.; José Oliveira dos Reis & Cabral, 2017; Awodele, 2012; Lengwe, 2014; Hung & Wang, 2016; Mai et al., 2016; J Plummer Braeckman & Guthrie, 2016).
	Geology	During the Feasibility Studies, detailed geological mapping of the project, geotechnical and geophysical site investigations are very cardinal during the planning stage so that if there are any relevant technical works to work around the geological situation is budgeted for. Due to the specificity of hydropower projects, the geological survey is done and analyzed before the commencement of the project. Even with the proper geological survey and technical advancements, a component of vulnerability stays in the sub-surface geography and the topographical amazements amid genuine	River Mini-hydro Power Project in the Province of Agusan Del Sur, The Republic of the Philippines; The Toshka Project -Egypt	(J Plummer Braeckman & Guthrie, 2010;Tolani, 2013a;B. Mishra et al., 2017; Taliotis et al., 2014; M. Shrestha, 2011; Kavishe, 2018; Dunn, 2017)

		development posing as a risk to the project. Hence, at the planning stage, all the needed data must be in place for onward incorporation in the scope of work and method statement. If this is not handled well, it is a recipe This, in turn, prolongs the time and cost leading to constructional delay risks.		
	Market dynamics	Revenue forecasting for HPP/PPP proves to be a challenge due to the project's lifespan. It requires detailed modelling packages incorporating several factors such as regulation and political risks. Future development of other sources of renewable energy must be taken into consideration during planning and a fallback point is critical. Germany is a typical example that developed subsidized solar and wind energy that affected the hydropower projects due to significantly reduced-price differentials. Seasoned changes that are in extreme effect the demand in most developed countries.	Assessment of future hydropower plants investments in Switzerland; The stated intentions for South Africa, Tanzania, Zambia, and Zimbabwe to introduce market competition have not materialized.	(IHA, 2019;Marketos, 2012;Eberhard et al., 2016;Byiers et al., 2016;Miranda Sarmento, 2014)
	Accountability / Transparency Institutional Capacity, Legal/Regulatory Framework	The well instituted regulatory framework plays a pivotal role in the protection of stakeholders on business and transaction vices. In line with the national development strategies and promotion of transparency and accountability, relevant stakeholders must be engaged during the planning stage. The regulation serves as a guild for the tariff negotiations and any other off-take terms. There are possibilities of the government changing the regulation retroactively affecting signed PPAs. The regulatory/legal risk can be covered, however, the developer should ensure it is following the best practice which provides adequate protection and responsibilities for all stakeholders involved in a PPP project. High sovereign rating, credible legal framework, institutional capacity, political stability, transparency, accountability, and reasonably red tape are some of the factors that influence private financing. The promotion of public	The Gautrain Rapid Rail Link project – South Africa; Kenya-Uganda rail concession; Metro Manila's Metropolitan Waterworks and Sewerage System (MWSS); The Beijing metro line 4 PPP project-China	(Sameer sadoon al-juboori, 2003;Massimo, 2012;Maria Jose Romero, 2017;World Bank, 2014;European Investment Bank, 2011;Yakubu & A. Anigbogu, 2016a);(Arezki & Sy, 2016;Olele, n.d.;Lengwe, 2014;Massimo, 2012;Fombad, 2013;Awodele, 2012;McQuaid, 2019;Shaibu,

		autonomy and the availability of relevant information is imperative in the PPP agreements (Armstrong, 2005).		2018;Coleman & Gfroerer, 2012;Khalil & Salem, 2017:Lee et al., 2018a;Liang & Wang, 2019;Armstrong, 2005).
	Resettlement and Rehabilitation Issues	HPP is a public related and sensitive project which can only be executed if the suitable geographical location is cleared, hence, implementation of resettlement and rehabilitation for the project affected people becomes a major issue. It contributes highly to the delay of the project execution, resulting in time and cost overruns. There is much opposition from the local people including International organizations/ environmentalists regarding the project. Thus, the planning tapping from the feasibility studies must critically consider the R & R issues so that the project execution is not affected.	Tehri, Sardar Sarovar, Indira Sagar- India; Kariba Dam-Zambia; Kosinj project-Croatia; Rugova – Kosovo; Bui-Dam Hydroelectric Power-Ghana; Akosombo dam and Kpong dam projects -Ghana; Bujagali hydro Project-Uganda	(B. Mishra et al., 2017;Sikorova & Gallop, 2015;Fynn & Abdulai, 2018;Kirchherr & Charles, 2016;Yankson et al., 2018;Obour et al., 2016;J Plummer Braeckman & Guthrie, 2016)
	Unavailability of skilled/expertise labour and material Shortage	The shortage of certain labour skills and expertise proves to be a challenge in developing nations. Material availability in land-linked countries is a challenge and causes project delays when there is poor supply chain management and logistics.	North and South Bank Kariba Power Station extensions-Zambia	(Osei-Kyei & Chan, 2017a;Tolani, 2013a;J. Li & Zou, 2014;B. Li et al., 2001b;B. Li et al., 2001b;Bing et al., 2005)

Compiled by Author (2019)

2.4.3 Project Procurement

Alonso,(2015), explains that the two significant issues that define whether a PPP project will be adequately successful or not, are the procurement procedure conducted and more precisely the risk allocation. Thus, this subsection identified the significant risks that can affect the procurement stage of the HPP and any major construction projects. Hence, risk allocation proves to be a key driver in the procurement process that cannot be overlooked as through an adequate assignation, there are high chances of having a proper project designed, built and operated successfully for both the public and private sector (Darvish, Zou, Loosemore, & Zhang, 2006). And the opposite is the continuous turbulence along the project life-cycle.

The procurement process is a crucial component of the project development stage as it involves acquiring material, consultancy services, and technical services needed for the project (Project Management Institute, 2008). This states that procurement includes any processes necessary to purchase or acquire products, services, or outcomes needed from outside the project team. The procurement process also includes the contract management and amendment/variations required to develop and administer agreements signed by the parties (Koven & Strother, 2007; Lamichhane Dhimal, 2018), Table 2.4 elaborates more on some significant risks associated with HPP/PPP at the procurement stage procurement and some case studies.

Table 2. 4: Significant Risks Associated with PPP/HPP at the procurement stage

Project Component	Risk Factor	Risk descriptions	Affected Project	Sources
	Payment default	The utility firm (The off-taker) may fail to meet the obligation of the purchase agreements for the output due to various economic issues. (Utility) maybe unable to accomplish payment obligations. That is the justification for private investors to demand a higher return due to the high perceived default risk. Hydropower projects require a high capital investment which must be recouped through higher tariffs within 20 years of operation. The amortization of the loans, dividends payments are put into consideration. Mitigation of this risk involves the creation of an escrow account with a minimum holding that could be established and, in some cases, the Government could issue a guarantee.	In the 1990s Asia and South America experienced a financial crisis that resulted in payment default; GTI Dakar and Kounoune, in Senegal (Both project companies defaulted on their loans to creditors at some point, largely because of payment delays by SENELEC); Hydropower Construction in Nepal.	(Sameer sadoon al-juboori, 2003; Sulser, 2018; Akrm & Alwahab, 2015; Judith Plummer Braeckman, 2008; Neupane, 2018; Devan, n.d.; Abd Rashid et al., 2016).
Procurement Stage	Local currency devaluation.	Most private investors need to secure some if not all, their debt in foreign currency but they earn their revenues in local currency. Thus, there is an exchange rate risk in an event that the local currency is devalued. This causes investors to obtain fewer returns during the conversion of the local earnings to foreign currency that significantly increases debt weight due to less money available to service the foreign-denominated debt.	Theun Hinboun (120MW) Lao PDR-Thailand; Kariba Phase 2-(Kariba North Power Project (1975 and 1976); Hydropower Project in Southern China reflected.	(Dambudzo Muzenda, 2009;Juan, 2006;Commission on Dams, 2000;Bruchez, 2014;Allie, n.d.;Hillson & Hulett, 2004)
	Corruption	This is unjustified tampering with the legitimate procurement process by both the public and private partners leading to an increase in project cost. Commonly, corruption misrepresents transparency and accountability by the government leading to increased market risks. It discourages private investors' decisions.	PPP Water Projects in China; Signed power purchasing by Tanesco with Independent Power Tanzania Limited (IPTL).	(Sobják, 2018; Kachapulula-Mudenda et al., 2019; “Empirical Study of Risk Assessment and Allocation of Public-Private Partnership Projects in China,” 2010;

				Coleman & Gfroerer, 2012; Ernest E. Ameyaw et al., 2014; Johnston, 2016; Farlam, 2005; Yehoue et al., 2014; Yehoue et al., 2014; Kachapulula-Mudenda et al., 2019; Likhitruangsilp et al., 2017; Sameer sadoon al-juboori, 2003)
	Exchange rate fluctuation	Exchange rate fluctuation affects construction projects especially in developing nations where almost all the important material has to be imported from the various developed nations using strong currencies. Increased local currency rates against other international currencies lead to high import costs. Developing nations with weak currencies, high macroeconomic, and financial instability are highly affected by this situation. Various governments manage this risk by through provision of incentives such as tax rebates on the imported project material and borrowing in foreign currency	Brazilian (in 1999); Argentina (in 2002), and the banking-related currency collapse in the Dominican Republic in 2003)	(Lobina and Hall, 2003; W. Bank, 2009; Reside, 2008; Allie, n.d.)
	Interest rate	Unexpected local interest rates are caused by immature local economic and banking systems uncertainties. This instability in interest loans Financial institution loans and financial projection of the project by the investors.	Brazilian (in 1999); Argentina (in 2002), and the banking-related currency collapse in the Dominican Republic in 2003)	(Zheng et al., 2018; “Empirical Study of Risk Assessment and Allocation of Public-Private Partnership Projects in China,” 2010; Yescombe, 2017; Sy et al., 2016; Juan, 2006; Yu, 2017; Nelms, 2012; Xiong, 2017; Hillson & Hulett, 2004; Sulser,

				2018; Nasieku, 2016; Ke et al., 2010);
	Force majeure	"Force Majeure refers to the risk that events beyond the control of either entity may occur, resulting in a material adverse impact on either party's ability to perform its obligations under the PPP contract". It is also referred to as occ "Acts of God", indicating the control which is beyond the control of either contracted party. These events include labour unrest, war, and many more which cannot be predicted. Hence, this issue must be appropriately finalized at the procurement stage (contract drafting). Usually, mitigation involves a renegotiation of project delay time, cancellation of liabilities, stimulus package by the Governments, and relaxation of certain regulations.	Jiangsu Sewage Treatment Plant in China; Nenskra hydropower project – Georgia; Hydropower Construction in Nepal	(Osei-Kyei & Chan, 2017a;Eberhard et al., 2016:Gatti et al., 2012;Tolani, 2013b;Dolla & Laishram, 2016;Yehoue et al., 2014;Nunzia Carbonara & Pellegrino, n.d.;Mouraviev, 2012; Mazher et al., 2017;Neupane, 2018)
	Political interference	This is an attempt to gain a biased advantage by influencing the production of a statistical product or service against the judgment of a non-partisan and apolitical statistical agent. Mostly, this leads to the selection of parties who are not technically competent for the projects and discourages potential experienced firms to tender their offers in the future.	PPP Water supply projects in Ghana; Inga Hydro Power Projects in DRC	(Effah Ameyaw & Chan, 2013;Pribadi et al., 2006;Devan, n.d.;Vardaro et al., 2016;Phiri & Ziba, 2018;Inga et al., 2010;Hillson & Hulett, 2004;Pr & May, 2019)
	Conflict between partners	Just like in a marriage, PPPs occasionally experience conflicts and disputes on various contractual issues. Thus, the appropriate mechanisms must be in place to deal with such matters. Therefore, during the contract negotiations, dispute resolution techniques must be prior agreed and enshrined in the contractual agreements before the signing.	Laibin B power plant in Guangxi Province-China; Bui dam project in Ghana.	(Hu et al., 2011; Shang Zhang et al., 2016; Ford, 2007; Yankson et al., 2018; Dunn, 2017; Osei-Kyei et al., 2017; Warsen et al., 2018; Anvuur & Kumaraswamy, 2006).

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Projects are not risk-free (Yescombe, 2017; Farquharson et al., 2011; Dikmen et al., 2008; Effah Ameyaw & Chan, 2013; Yakubu & A. Anigbogu, 2016). And this statement has been supported by the risks which have been identified at the project development stage of the HPP/PPP from various literature surveys carried out by this author. This justifies the importance of having a well-designed risk management framework for the enhancement of the success of these complex projects(Mccann & Busadm, 2014; Judith Plummer Braeckman & Guthrie, 2016; Wet, 2016). With the growing need for renewable energy in developing nations and Zambia to be specific, this framework is bound to be appreciated by many stakeholders who have embraced the PPP phenomenon.

2.5 Effect of risks and the probability of occurrences at Project Feasibility, Planning and Procurement Stage for Hydro Power Projects.

This section discussed the effects of the risks and probability of occurrence on HPP/PPP frameworks and models. Various risk analysis techniques used to examine the probability and impact of the risks on project objectives are also discussed in this section. This stage in risk management is referred to as Risk Analysis. Examples of some selected construction projects have been presented regarding risk analysis.

2.5.1 Risk Analysis

Risk management does not only stop at-risk identification but the identified risks must be analyzed, to assess the probability of occurrence and effects/impacts on the project objective (Ameyaw et al., 2014; Likhitruangsilp et al., 2017; Jakutyte,2012; Ajith, 2019; Haseeb et al., 2014). Yshuwan et al., (2008) point out that the two elements of risks are the probability of occurrence and the impact it does on the project objective. Thus, proficient managing of risks forms a good basis for good corporate management, governance, and is fundamental to achieving value for money and sustainability of project outcome. Subsequently, the analysis leads to risk allocation to the parties with the capacity and wealth to handle the risks for enhancement of project delivery accomplishment (Lu & Carrillo, n.d.; Chou & Pramudawardhani, 2015; Wang et al., 2019; Chan et al., 2011).

This section expounds on the qualitative and quantitative analysis techniques being used on mega construction projects ending with the recommendation for the HPP/PPP. Due to the complexity of the hydropower construction projects, there is a need for a harmonizing and having interdisciplinary approach in the handling of risks qualitatively and quantitatively to achieve the intended goals (Dziadosz & Rejment, 2015).

2.5.1.1 Probability of Risk Occurrence

Desgrées du Lou(2012), enumerated that the likelihood of risk occurrence and its impact can be minimized or eliminated by the project stakeholder's efficacious actions. Also, Akintola et al. (2003) and Winch (2010), echoed that there is a relationship between the source of the risk and the likelihood of occurrence. With the aid of the cognitive model Winch (2010), deduced that likelihood of events happening in the future, can be drawn from a deep analysis of historical similar events. Hence, historical data is very cardinal for the prediction of future events with the aid of qualitative and quantitative techniques illustrated in sections in this chapter. Abednego and Ogunlana (2006), emphasize that when risk events occur, the order must be maintained and resources must be available to compensate for the probability of loss on behalf of others. And it is cardinal that the value is determined for each risk about the monetary consequence and likelihood of occurrence (Abednego and Ogunlana, 2006). According to Moralles et al. (2009), risk value is obtained by the product of consequence x likelihood of occurrence. It is at this point when quantitative analysis is applied to get the absolute value of the risks. This author deduces that the calculation on the probability of occurrence is multifaceted on mega PPP construction projects, due to the need to predict or estimate the risk. Since in some cases the estimation method is based on little information, the project manager must use as much mental power as possible. And it is at this point that the number of experts is highly suggested. Hence, this research in its research methodology, the Delphi technique (Arimah, 2017; Dunn, 2017; Yu, 2017), was used to determine the probability of the risk occurrence and impact on HPP/PPP.

2.5.1.2 Risk Impact/ Effects on the objectives

Nurdiana et al. (2015), explains that risks in huge construction projects are not eliminated, but their influence can be minimized. To achieve desired objectives, risks must be managed properly and that inters critical understanding of the impacts /effects on the stakeholders (Wang, et al, 2004;

Andi, 2006). Once an effective risk management process has been conducted by the project manager, it becomes easier for the analysis of the potential impacts on the project with the needed mitigation measures (Xenidis and Angelides 2005). Ameyaw et al. (2014), states that the Delphi method as a qualitative analysis has been used on various PPP projects to determine the risk impacts, a case of water supply projects in China. This technique is integrated with a five-point Likert scale (Stefan, 2014).

The Risk Effect/Impact is calculated as follows:

Risk Effect = *Likelihood of Risk Event* **X** *Severity of Impact* (Osei-Kyei et al., 2017)

However, (Pribadi et al., 2006), notes that the impact of risks on a project does not always post negative sentiments to the investment, as there are cases where certain events lead to positive impact.

2.5.2 Risk Significance

Risk significance is articulated as an amalgamation of its impacts on project objectives, and the probability of those impacts arising (Tolani, 2013b). Hence, the significance of risk factors is achieved by the square root of the product of likelihood and severity scores based on the Likert scale results (Osei-Kyei & Chan, 2017b; Dunn, 2017; A. Shrestha, 2015). Measuring the risk significance provides risk ranking in order of impact on the project (Chaaya, 2018) and prioritization (Iyer and Sagheer 2010). However, in calculating an arithmetic product of a risk significance specifically, to arrive at more manageable numbers, there is a need for applying square roots (Xu et al., 2010). Square roots once used in statistics bring data closer to the normal distribution (Howell 2007).

$$\text{Risk significance} = \sqrt{\boldsymbol{Probability} \times \boldsymbol{Severity}}$$

(A. Shrestha, 2015)

This research deduces that the importance of risk significance is that it enables PPP stakeholders to fully understand the risks and have the confidence of handling them if allocated to them. That is the reason the PPP stakeholders should consider all risks associated with the construction project at all stages. The construction project, in particular, the HPP/PPP are so complex as stated in the earlier section of this research, thus, when quantifying the risks at the project development stage and the subsequent stages, all case scenarios must be simulated. Also, the party allocated to manage risk on the project should have the capability, experience, and be well vested with relevant statutory requirements. This research endeavoured to develop such a robust risk management framework through the integration of selected qualitative and quantitative risk analysis techniques elaborated in the research methodology (chapter five).

2.5.3 Qualitative Risk Analysis

This is a simplified technique of analyzing risk, as it only gives data in terms of how the risks affect the project about low, medium, and high significance. This simple analysis prepares the data for further analysis which is quantitative (Korombel & Tworek, 2009a). Wilhelm, (2009) explains that the risks are presented in terms of probability of occurrence and impact represented on a probability-impact grid as shown in Table 2.5 and 2.6. The risks are intuitively assessed using qualitative scaling aspects (high, medium, and low) which are converted into values or weights. Hence, the analysis is based on nominal or descriptive scales for describing the probability and impact of risks(Stefan, 2014). The probability and impact scores are multiplied to obtain the risk scores. And the product of the two variables-probability and impact gives risk exposure (Aldrete et al., 2010; Ke et al., 2012; Y. Zhang, Gu, Shan, Xiao, & Darko, 2018). Table 2.5 and 2.6 illustrates a simple model of the probability - impact classification and Impact Analysis respectively.

Accordingly, it can be deduced that the qualitative technique step requires capability, involvement, information, and creativity since it is subjective (Emblemsvåg & Kjølstad, 2006). The dependence on subjectivism by the use of qualitative analysis demonstrates to be a challenge as it has the potential to produce widely dissimilar results (Backlund and Hannu, 2002). A qualitative assessment has the following characteristics (Stefan, 2014);

a.) It proves to be a fast and easy task;

b.) It is regarded as more accessible and policymakers easily get acquainted ;

c.) There is no use of complicated arithmetic's

d.) It provides preliminary data for decision-makers.

Due to the complex nature of construction projects under the PPP model (Byiers et al., 2016), the risk analysis process is done systematically and procedurally. The risk analysis system has three phases that are planning stage, the risk assessment stage, and the risk mitigation stage (Korombel & Tworek, 2009b). The gathering of the project information is done at the planning stage, while at the assessment stage, there is the identification of risks, probability of them occurring, and the impact of the project objective. This leads to a deep appreciation of the risk appetite (Rajé, 2017; Bosetti, 2015; Ernst and Young, 2017). The final stage is risk mitigation(Pilcher et al., 2004; Hovy, 2015), this is the treatment of the risks (Miranda Sarmento, 2014; Haglund, 2017), influenced by the technical expertise, institutional capacity and wealth of the organization. Figure 2.2 shows the risk analysis phases.

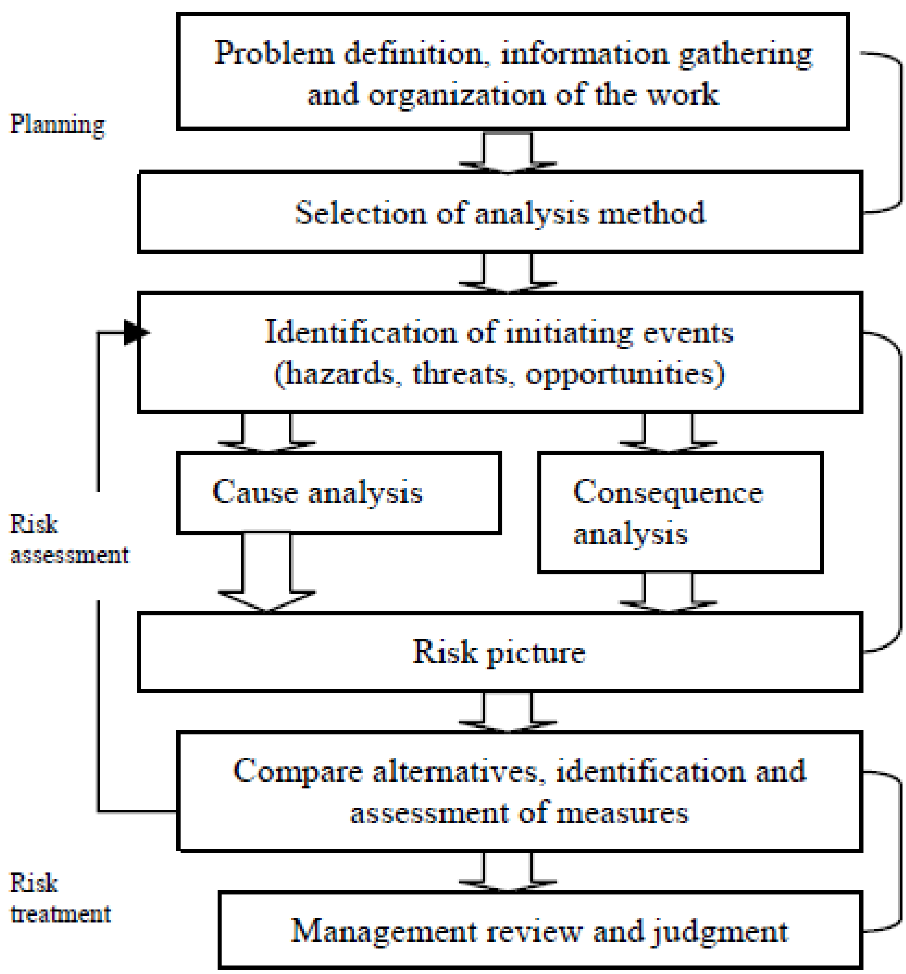

Figure 2. 2: Phases of the Risk Analysis Systematic Process - Source (Korombel & Tworek, 2009b)

Concerning the qualitative technique, Abrahamson (1992) illustrated that risks must be allocated within the party's control. However, the term control is subjective and relatively difficult to get a precise interpretation of it (Emblemsvåg & Kjølstad, 2006). It is at this point that Abrahamson (1992) stated that the integration of the fundamental principles when deciding the risks, the importance of qualitative judgment, and experiential knowledge plays a pivotal role in project success (B. Li et al., 2001b). However, the challenge of this kind of decision-making process is its implicitness (B. Li et al., 2001a), making it difficult to be analyzed by other stakeholders.

Table 2. 5: Probability and Impact Classifications

Classification	**Score**	**Impact Classification**	**Score**
Low	1	Major	3
Medium	2	Medium	2
High	3	Easy	1

Source: (Dumbravă & Vladut-Severian, 2013)

Table 2. 6: Impact Analysis

Magnitude of Impact	**Impact**	**Score**	**Rate**
High Impact / High Probability	**Very High** They are the biggest risks that entrepreneurs should pay	**5**	**A**
High Impact / Medium Probability Medium Impact / High Probability	**Very High** These risks have either a high probability of occurrence or a significant impact	**4**	**B**
Medium Impact / Medium Probability	**Medium** There is a Medium Chance that the risks appear noticeable impact	**3**	**C**
Medium Impact / Low Probability Low Impact / Medium Probability	**Low** These risks can occur in some situations and have a low to medium impact	**2**	**D**
Low Impact / Low Probability	**Insignificant** These are risks with a low probability of occurrence and low impact. Can therefore be neglected.	**1**	**E**

Source: (Stefan, 2014)

2.5.3.1 Limitations of Qualitative Risk Techniques

Risk analysis to be effectively executed, requires technical experience (Balkans, 2018), project information (Olawumi & Chan, 2018; Boyé & Vivo, 2016), and inventiveness (Johnston, 2016). However, for qualitative analysis, the process is very subjective (Lyons & Skitmore, 2004). The limitations come in because of this subjectivism which proves to be a challenge as it has the probability of producing broadly dissimilar results (Backlund and Hannu, 2002). This infers that the accuracy of the exercise depends on the team's experience which has the chance of some risks being left out. If the team assessing the risks have not experienced a project type, they might miss some risks or assess them inadequately. Also, the process lacks differentiation as when the identified risks are categorized in the same block such as the high probability of occurrence and low impact, it gives no room to differentiate the severity of the risks and prioritization. However, PMI (2003) settles that the output of the qualitative assessment does not give an accurate risk estimate, but, it gives a descriptive result with adequate data for planning purposes. For quantitative analysis, these are the results which plays as inputs, thus, qualitative analysis must be performed throughout a projects life cycle since new risks may come up through the cycle. Table 2.7 presents some of the risk analysis techniques used on projects briefly describing their, advantages, their limitations and critical success factors.

Table 2.7 briefly explains some of the qualitative risk assessment techniques that are applied to various construction projects. The best practice for the project to select the technique, there should be high familiarity with the advantages and disadvantages of the definite technique. This aids in choosing the most suitable technique for application on the risk assessment technique. Nevertheless, qualitative analysis is subjective and the accuracy of the application of this technique depends on the experience and proficiency of the project team members, there is a need to combine quantitative techniques (Simmons et al., 2017; Pribadi et al., 2006). Thus, section 2.4.3.2 elaborates on some of the quantitative analyses applied in mega construction projects.

Table 2. 7: Qualitative Risk Analysis Techniques, limitations, and Critical Success Factors (CSF) for Effective Implementation.

S/no	**Analysis Technique**	**Description / Advantages**	**Disadvantages / Limitations**	**CSF for Implementation**	**Source**
1	Probability / Impact Matrix	The matrix demonstrates the risk exposure/severity through the multiplication of the probability of occurrence and impact of the risk on the objective. Through ranking, project managers can determine if it is the probability or the impact that is attributing to the severity. It is from the background that the best mitigation measure is drawn from a particular risk. It also provides the platform for prioritization of the risks for further analysis (quantitative).	It is limited to probability and impact such that it does not take into consideration other factors such as management issues, earnestness, and aesthetics that contribute to the determination of risk ranking. Due to its limitation in making comparisons with other risks, it provides limited value.	The data must be clear and explicit when allocating levels of Probability and Impact. There is a need for experience and techno-know in the approximation of consequences and likelihood in terms of low, medium, and high. The perception and definition of risk parameters must be adequately understood by all the stakeholders so that the designated levels of the high, medium and low are objectively applied.	(Elmontsri, 2014)
2	Bow-Tie Analysis	This is a pragmatic risk assessment technique that tackles and determine causal relationships in risk setups**.** Bow-tie analysis not only does it identifies the risks but also provides a full analysis of all types of hazards, consequences, preventive and recovery barriers, including escalation and escalation factors. It provides comprehensive and structured operative picturing of mitigation measures of the causes and impacts discretely. It handles the risk on both of its sides by mitigating the	As much as it is a comprehensive and structured assessment tool, construction projects still need a quantitative approach to complement. The full appreciation of this technique is enhanced by the experience of the project members and full participation. It has not provided priority and ranking of risks. There is a high requirement for in-depth knowledge of the system and its connecting components to conform to the bow tie sharp. There	Well established leadership is needed for setting up the team, responsibilities, and in-depth comprehension of the technique. An institution in terms of personnel and technology is critical. Testing of the performance results is cardinal and also well-established integrity portfolio in Asset reporting.	(Hamzah, 2012**;**Sneddon, n.d.**;**IP Bank B.V., 2015)

		likelihood of occurrence and minimizing or limiting the impact.	are no known standards procedures and representations of bow-tie plans. Some researchers deduce that this technique does provide or present the confidence if the bow tie components (hazard, top event, barriers, escalation factors, and barriers) are exhaustive and safe for the projects to proceed.		
3	Delphi Technique	A group of experts independently respond to 2 or 3 rounds of the survey. The responses from the expert are compiled and reviewed by the experts until the consensus is reached. This technique applies to both risk identification and analysis. There is no requirement for physical interaction with experts who can be drawn from various geographical locations. Since respondents are anonymous, it emboldens originality, trustworthiness, and a balanced looking at ideas.	There is a need for standardization in the interpretation and analysis of data. Also, the selection of participants must have some universal guidelines. Due to many rounds in striving to get the consensus, the process is time-consuming and involving. The smaller size (about 15-20) is a limitation in the generalizing of the results.	The validation of the Delphi results through the triangulation process. This inters perfecting the Delphi technique with another research method. The use of electronic platforms is easier and eliminated several errors including fatigue which leads to giving wrong answers. Recruitment of participants with interest in the research topic, effective communication, and setting firm deadlines.	(Fink-Hafner et al., 2019);(Donohoe et al., 2012); (Kashiwagi & Kashiwagi, 2012);(Olawumi & Chan, 2018);(Okoli & Pawlowski, 2004)
4	Root-Cause Analysis (RCA)	This is frequently used in the analysis of catastrophic losses to investigate the causes and coming up with preventive measures to avoid future re-occurrence. It advocates for continuous improvement not only corrective action.	There is a potential to overgeneralize and overshadow other existing possible causes. Without the proper strategy to address the root cause, the whole exercise is in futility.	The project terms members must be abrasive and possess the ability to identify the associated risks. Management support and buyout in the process are very motivating for the team members to work around the process.	(Korombel & Tworek, 2009b;Pilcher et al., 2004;Technology, 2017;Awodele,

		It also can identify other unknown risks that may not be inherent. The process is comprehensive and proactive in the handling of various risks.		The availability of valid information from various resources is prominent.	2012;Valis & Koucky, 2009)
5	Project Historical Data	This technique enables reviews of previous risk registers and projects to draw some lessons on experience. Project teams are assisted by this technique to take up opportunities that were missed last time due to some mistakes. It aids in the allocation of resources by referring to previous errors committed or lessons learned.	The absence of reliable and adequate data disadvantages the process to produce an accurate risk profile. The collection of extensive data could be an expensive and technological risk that is the potential to retrieve the data. This technique could be misleading due to reliance on only risks that were experienced previously on the project. Incomplete information, full details of resolutions made, and some strategies employed were not documented.	Proper documentation of lessons learned, experience, and standard compilation of risk registers. Previous team members must form part of the new team to analyze the previous projects. Expert knowledge in a particular field must be present to successfully use this technique	(Xiong, 2017;OECD, 2014;Attarzadeh, 2014;Factors et al., 2012)

Compiled by (Author, 2019)

2.5.3.2 Quantitative Risk Analysis

A quantitative approach is based on the use of quantitative (numeric) data available rather than descriptive scales(Andrade & Loiola, 2013; Pribadi et al., 2006; Ling, n.d.; Dumbravă & Vladut-Severian, 2013). Norman (2010) explains that the use of risk quantitative analysis enables the examination of the problem from enough points of view to enhance the measurement of elements that can be utilized in making a valid conclusion. Akrm & Alwahab (2015), echoes that another technique for the quantitative assessment is that it holds a decisive approach that measures project outcome impacts with varying values at different times. Furthermore, the quantitative technique assesses the risks through the representation of the probability and impact of monetary terms and duration(Lamas et al., 2014). A Likert scale is usually used when measuring the five-point scale (Dolla & Laishram, 2016; Cerimagic et al., 2015) for the probability and consequences. In a mega construction project, the assessment of risks must be comprehensively executed to obtain the cost and benefits estimated values for the key stakeholders (Dumbravă & Vladut-Severian, 2013). Additionally, the risk assessment needs to capture all sides of activity in a Likert scale pattern such as:

a.) Risk probability (very high – very low(Lau Siew Soon, 2012; N. Carbonara et al., 2015).
b.) Risk levels (extreme -negligible);
c.) Impact (insignificant – catastrophic)(Dumbravă & Vladut-Severian, 2013).

The consistency component of mathematics makes it a great virtue such that in risk analysis, the absolute values are obtained instead of mere speculations making quantitative analysis explicit. Table 2.8 illustrates some of the quantitative risk analysis techniques mostly used on construction projects and their limitations. It is worth noting that several other risk calculations fall within the main packages such as mean score method (Seow et al., 2014), correlation analysis (Hillson & Hulett, 2004; Chaaya, 2018), Mathematical/analytical technique (شجاع، ی ارؤ ي, 1393) and many more.

As much as there are many techniques to use, the determining factors include project size, how complex the scenario is, availability of time and resources, and preciseness statistical outputs required (Akrm & Alwahab, 2015). The author further concludes that to get a comprehensive risk analysis position on a complex project like hydropower, a combination of qualitative and quantitative risk analysis must be applied as the techniques complement each other's limitations.

Table 2. 8: Quantitative Risk Analysis Techniques, limitations, and Critical Success Factors (CSF) for Effective Implementation.

S/no	Analysis Technique	Description/Advantages	Disadvantages/Limitations	CSF for Implementation	Source
1	Analytical Hierarchy Process-(AHP)	This is a multi-criterion comparative evaluating scientific technique that handles both the subjective decision and the objective measures. It is easily applied and the calculation dealing is not difficult which makes it appropriate in the comparisons of several factors during the selection process. It is a robust technique with the capability to handle ambiguous, vague, and subjective data during the ranking of risky situations identified. Finally, the AHP technique establishes a connection between criteria and alternatives.	Lack of clarity in the differentiation of many risks. It is the reliance on the mathematical method. It is timing consuming and prone to errors. It does not disentangle models that are not in a straight platform. The process involves so much mathematical calculation that becomes so deeper when handling complex projects and is very exhaustive.	The risks must be arranged into a hierarchy of criteria for easy analysis and comparison. The team members must be well acquainted with mathematical calculations to handle complex projects. Finally, for the best decision to be made, it should be reliable and coherent with the objectives and outcomes of the project.	(Atanasova-pacemska et al., 2014;Awodele, 2012;Anvuur & Kumaraswamy, 2006;Saaty, 1987;Kaliyamurthi, 2017)
2	Sensitivity Analysis	This technique is used to examine the effect of input variables on the risk model-dependent outputs. It aids the project decision-makers to weigh how different ratings change when certain factors are altered. It is highly used to measure the financial sturdiness of the project. Some examples of independent variables that can be manipulated to determine the output are; project duration, interest rates, inflation rates, operational costs, demand. etc	It does not take into account the relationship between the independent variables. It allocates the same likelihoods of occurrence to all the situations. The technique proves difficult to analyze risks when the number of independent variables and situations is large in complex projects.	Commitment and Top Management Support. Effective communication among the team members. Information and Communication Technology Infrastructure. Appropriate organization structure, management style, and culture. In-depth understanding of the risk management process.	(Marketos, 2012;Kasperczyk & Knickel, 2014;Alfen & Wilhelm, 2009;Commission, 2017;Wong & Kelley, 2010;J. Li & Zou, 2014);

				Training in the usage of sensitivity analysis tools.	
3	Monte Carlo Simulation	This is one of the most commanding techniques for financial modelling in risk management. It uses Net Present Value and Internal Rate of Return to reflect the results. The advantage is that it handles multi- variables with substantial uncertainties and scenarios. Thus, this tool becomes useful in a very complex project with several uncertainties such as hydropower projects sustainability risks. It enables management to have a grip focus on the future and developing an optimum strategy based on present and historical data.	Monte Carlo Simulation provides estimates of probabilities of success and failures, not the precise scenario. This technique is complex and requires a lot of data for simulation thus outputs are only delivered after sufficient empirical sufficient data or many rounds of assumptions are made. It provides challenges in solving back calculations. The technique also fails in the accounting of futuristic markets, financial crises, and global recessions.	Project stakeholders must be highly competent with computation skills, risk management processes, and a deep understanding of the application of multi variables in a simulation situation.	(Franke et al., 2019;Hillson & Hulett, 2004;Tang et al., 2018;Alfen & Wilhelm, 2009;De Marco & Jamaluddin Thaheem, 2014;Firmenich, 2014;Anh Nguyen et al., 2017;Commission, 2017; Desgrées du Lou, 2012;Carlo & Carlo, n.d.;Kurniawan et al., 2015;Kurniawan, 2013)

4	Decision Tree Analysis	These are outstanding tools that aid the project team members to choose among the several options present to them before making a final decision. It can present a platform for decision-makers to interact with various options and examine the probable consequences of selecting those choices. It aids in forming a well-adjusted image of the risks relevant benefits of the decision made. The advantages include; The problem is presented for the challenge of all options and a full analysis of the possible impact of the decision. The outcome values are quantified and provide the course of the probability of attaining the same. Finally, it aids in making the finest verdict based on prevailing data.	Extreme precision must be applied in the handling of data as a minor alteration results in a drastic change in the assembly of the decision tree. The calculations are complicated for some decision-makers with a poor background in algorithms. It takes more time and costly training activities. This technique falls short in the application of regression analysis and forecasting continuous values.	High support and commitment of the top management. The integration of change management principles in the organization. There is also the need for a fixed budget for this exercise. Training of the team members on the process is vital.	(Version, 2003;Emblemsvåg & Kjølstad, 2006;Hillson & Hulett, 2004;Charel & Galarreta, 2007;De Marco & Jamaluddin Thaheem, 2014)

Compiled Author (2019)

2.5.3.3 Knowledge Gap Analysis

In the attempt to manage the inherent risks which affect mega construction projects, various tools and techniques are used. These tools are applied for identification, analysis, allocation and mitigating risks. Conversely, some of these tools are based on statistical theory such as the central limit theorem. However, this remains a challenge in some complex technical projects with little or no relevant previous experience at all. Furthermore, Innumerable risk analysis and management tools/ practices have been acknowledged in the literature survey conducted. However, the issue of risk identification, analysis and allocation among project partners remains the weakest link in the risk management process leading to project failure. Most studies have strived to solve the challenges of managing risks, but have rarely investigated the development of having a risk management framework specifically for the project development stage.

Furthermore, skill and knowledge on risk management systems have been cited in the literature as barriers to project success. However, it is not clear what deficiencies there are in the skill and knowledge of the involved parties. It is also indistinct from the current contextual Zambian PPP legal framework what risks do affect hydropower projects at the development stage and what practices are used for risk management. It is also not clear how risks are allocated among the PPP stakeholders. All the above-mentioned are gaps that need to be addressed to be able to formulate a risk management framework for HPP/PPP in Zambia with the incorporation of; Robustness- having the highest degree of uncertain variation to mitigate all the loopholes of causing project failure and; Decision- ability to make decision and analysis of the variables to enhance the robustness and opportunity costs.

2.6 Overview of Risk Management Framework / Model Development

From the literature survey carried out by this author, the successful implementation of PPP projects is heightened with a well-designed objective, robust and reliable risk management framework/model (Grant 1996; HM Treasury 2000; Li et al. 2005; Jin and Doloi 2008). Thus, several risk models have been developed by many scholars of risk management to apply in various sectors (Sachs et al., 2007).

Longman (2012) defines a framework as *"an object or phenomenon that shares important characteristics with the object or phenomenon, and which allows a complex system to be understood and behaviour within that system to be predicted, by simplifying detail".*

FED (2011) defines a *model as "a quantitative method, system, or approach that applies statistical, economic, financial, or mathematical theories, techniques, and assumptions to process input data into quantitative estimates".*

From the definitions, it is realized that a framework is made up of three segments. These include; data input component to transmit the independent variable, a processing unit that converts input variables into assumed estimates, and an output component that channels the assumed estimates into useful financial and business information (FED, 2011). The various techniques commonly used include but are not limited to;

2.6.1 Frameworks/Model use in HPP/PPP

Alien Eye's Risk Model is among the common models used on projects reflecting the risk hierarchic ranks with its relative significant relationship among the other identified risks (Chan et al., 2010). Many risk models have been developed and applied to several projects in many countries (Osei-Kyei et al., 2017). For instance, a model named QQIR was developed for computing (quantifying) qualitative information on risks. This model linked the gap between qualitative and quantitative risk assessment methods. Fuzzy set theory was integrated into deriving customized probabilistic data in risk assessment and financial modelling (Sachs and Tiong, 2009). Another study had used a model with multiple linear regression in determining the causal relationship between multi variables to achieve optimum risk allocation in PPP projects (Jin and Doloi, 2008).

Chan et al.,(2010), recommended that future PPP construction projects must integrate non-probability analytical techniques and non-linear relationships. Following the challenges encountered in hydropower projects in Vietnam (Mai et al., 2016), a risk model was developed. The technical inputs into the risk model developed in Vietnam were the risk variables. The variables were built utilizing mainly the analysis of previous research and consulting experts. The gathered data helped to form the questions. Thus, a Delphi process was used due to the benefits realized from the experiences and knowledge of the experts assisted in the selection of reasonable questions. Through effective use of the Delphi technique, a summary of risks that affected hydropower projects was established, and the risks were ranked under its significance. An additional example is the SEM model simulation which was developed, to achieve the best output on this model, identification, and analysis of factors, investigation, and observation of independent variables, reliability testing of inputs are conducted in the first components of the model to enhance the output (Mai et al., 2016). The development of a risk model on a particular project is advantageous as it allows for the determination of various risk management complications (Reddy & Sharma, 2017; Taran, Boer, & Lindgren, 2013; Kashiwagi & Kashiwagi, 2012). Figure 2. 3 shows a field model that was developed with various risk hypothesis inputs and other statistical inputs such as chi-square and Cronbach's Alpha reliability coefficient.

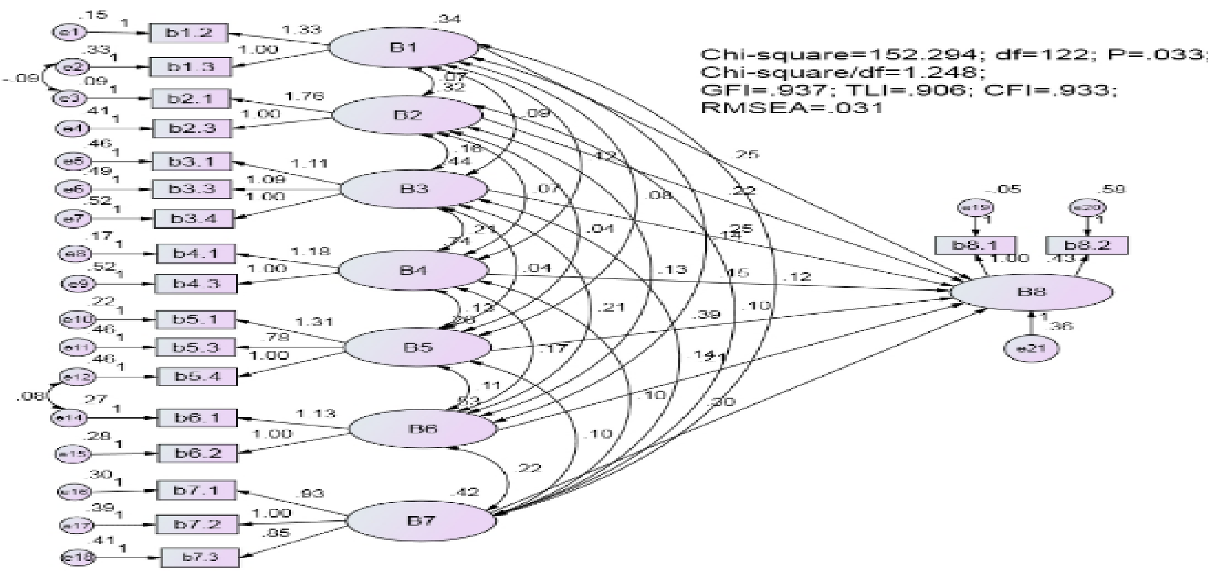

Figure 2. 3: Example of SEM Model – (Source: Mai et al., 2016)

There are many more scholars who have developed models and frameworks concerning risk allocation in PPP projects. Medda (2007) developed a risk analytical model with the integration of game theory which worked on the risk allocation process between the PPP partners. Another model was developed to look at optimum risk allocation among the PPP stakeholders during the concession period and achievement of Value for Money (Carbonara, Costantino, and Pellegrino (2014a). With the uniqueness of projects (Santoso, Wijayanto, Notodiputro, & Sartono, 2017; Cheung, 2009; Sobják, 2018), risk criticality appears to differ significantly across countries, across sectors and even across projects. Thus, this justifies that a generalized framework/ model is not ideal and effective due to the uniqueness of infrastructure projects.

Framework/Model development is also a risk activity (Ruiz, 2015), as there are possible problems based associated with inappropriate framework/models and in some cases mismanagement of the output. Aggarwal et al., (2016), agrees that the application of framework/models habitually has some potential risks such as financial, coding errors, poor transcription, business decision and technical risks which can affect the output. Ruiz (2015), cited the causes of risks that can render the developed framework/model from giving out the needed output as follows:

a) Intrinsic (within the control of the project team) – data deficiencies, estimation uncertainty, the complexity of the model process, business applications, and inadequate testing.
b) Extrinsic (outside the control of project team) – model implementation/use controls, systematic risk drivers such as uncertainty in volatility, correlation, unexpected movements in economic risks that include; interest rate, exchange rate, inflation, and taxation.

According to (Ruiz, 2015), three examples of developed models which had errors and caused a substantial financial loss to the projects are;

(a) London Whale (2012) – models error caused USD5.8 Billion of trading losses
(b) Banamex (2002), Modeling teams destroy approximately 5 years' worth of default data due to faulty data processing. Computer literature suggests that the value of 100 megabytes of data is valued at approximately USD 1 million.
(c) Bank of America (2014) – data/process error caused USD 4 Billion reductions in reported capital.

Nevertheless, Paper (2017), presented some mitigation measures for framework/model risks which included; suitable and comprehensive input data, the conceptual approach must be reviewed, effective monitoring of the process and validation of variables. Other mitigation factors presented were outcomes analysis, including back-testing and conservatism factors. Despite having a diverse risk model developed for the IT industry, road construction industry, energy sector and health infrastructure (Kashiwagi & Kashiwagi, 2012), organizations develop models to specifically cater for one of the following principles (Accenture, 2009);

a.) The project to comply with relevant regulations, legal frameworks, and guidelines.

b.) To minimize and eliminate the risks on the project to enhance the achievement of Value for Money, good business decisions, and a clear understanding of the financial projections (Taran et al., 2013).

Nevertheless, this research envisaged developing a framework that critically tackles the compliance and regulatory aspect, value protection for the project, and also for value enhancement to cover all dimensions of HPP/PPP. The involvedness inherent nature of construction projects attributes to several potential risks (Parker, Dressel, Chevers, & Zeppetella, 2018; Ye et al., 2018; Suđić et al., 2017), however, Kashiwagi & Kashiwagi (2012), disagrees with this insinuation but attribute it to the poor systematic management of projects, non -adherence to the environmental issue and not fully comprehending the severity of the risks. It is further argued that a lack of expertise in a deep understanding of PPP arrangements and the best practice around the world could be a major source of risk (Kashiwagi & Kashiwagi, 2012). Figure 2.4, shows the Risk Management Framework on a PPP project life cycle to accomplish a balance of interests between project stakeholders in the achievement of value for money and sustainability.

In the Zambian Context, Tembo (2018), the challenge was established of contract price practice which was mirrored in contractor's selection criteria and contract conditions and weak risk practice exhibited in unsystematic and un-formalized risk management practices. The author states this contributed to risk misallocation and subsequent poor performance of the building sector. Thus, to ameliorate this challenge. Tembo (2018) developed a Generic Risk Allocation Framework. However, the developed framework was only covering risk allocation, not any other components such as risk identification, analysis and mitigation. Moreover, the framework developed was not specific for a particular construction project. The Generic Risk Allocation Framework is shown in figure 2.5

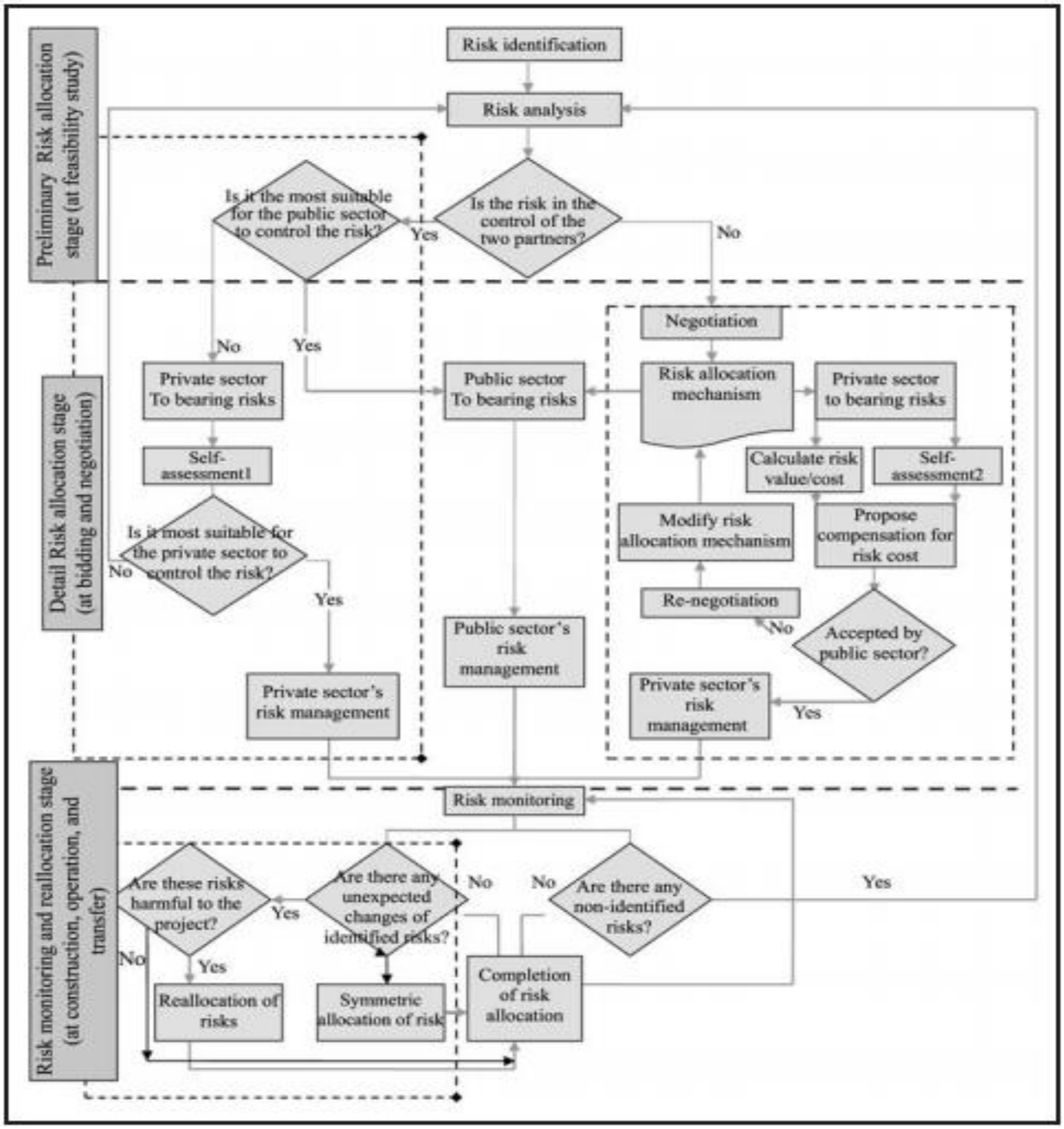

Figure 2. 4:Risk Management on PPP Project life cycle - Source : (Zou et al., 2008a)

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Final Generic Risk Allocation Framework

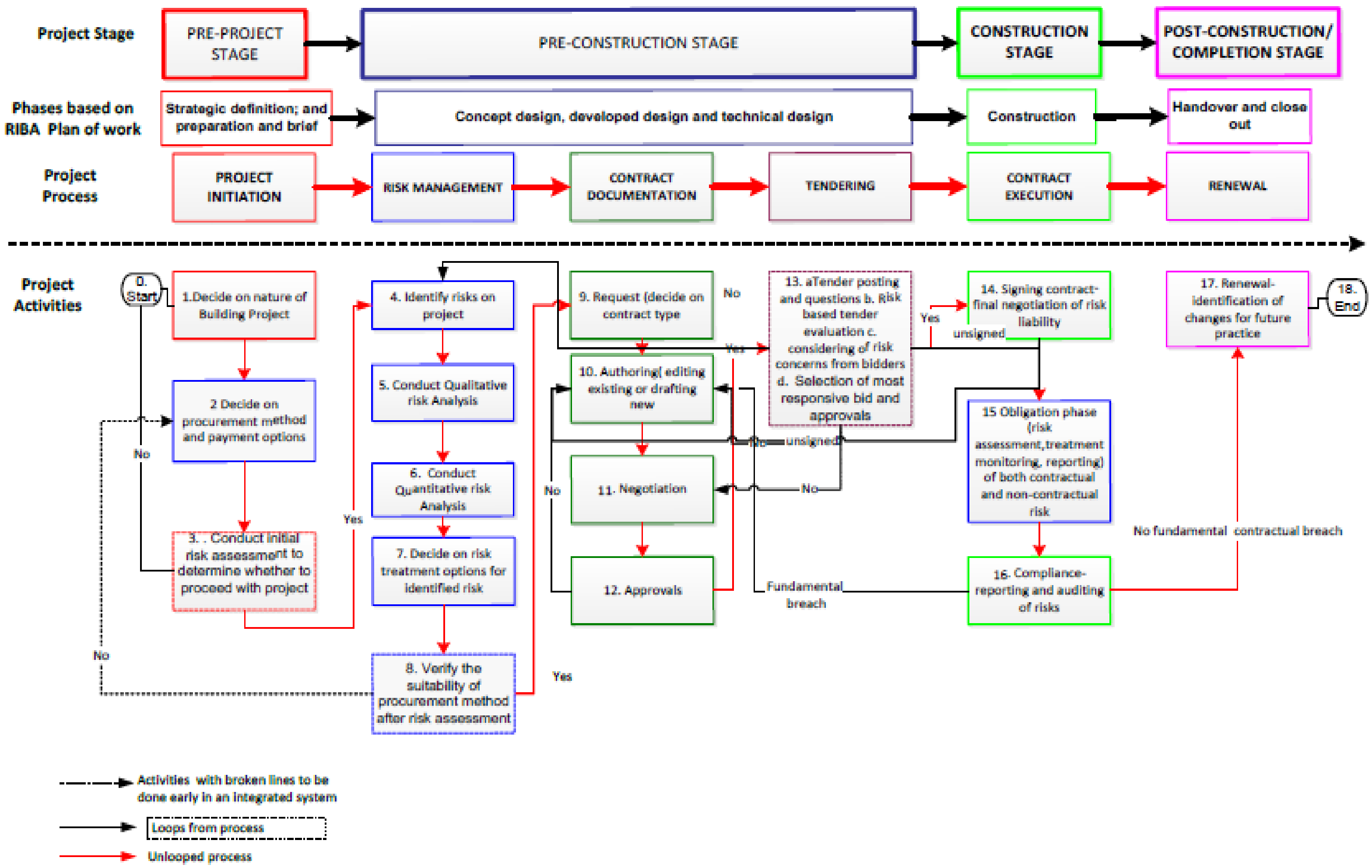

Figure 2.5: Generic Risk Allocation Framework Source (Tembo,2018)

Other methods established by vigorous literature survey which are being used in hydro projects regarding risk management include;

2.6.2 Integrative Dam Assessment Model (IDAM)

In achieving instantaneous competitive needs for energy, water, and environmental security with a sustainability mindset, there is a need for a comprehensive understanding of the dam's characteristics. Tang et al (2018), explains that the sustainability appraisal of hydropower is a multi-dimensional facet. It recommends supplementary interdisciplinary and robustness with regards to decision making on the large dams, hence, an integrative dam assessment model known as IDAM plays a pivotal role(Kibler, K., D. Tullos, B. Tilt, A. Wolf, D. Magee, E. Foster-Moore, 2012). Besides,(Ndirangu, 2014), exemplifies that the IDAM tool has the capabilities of integrating biophysical, socio-economic, and geopolitical standpoints into a package of cost and benefit analysis of dam construction. This decision tool has been used by policymakers at the global level in holistically realizing the challenges including the cost-benefit analysis of the dam project. Therefore, this designed model is imperious as it can identify the costs which hereafter known as risks and the domineering aspect of it is that its approach is based on sustainability (Bozkurt & Akif Destek, 2015; Wolf. et.al, 2009). Brown et al.,(2009), cited a case study of the hydro dam project on Nu River in China where the sustainable appraisal was carried out using the IDAM. The analysis results for the parameters presented the prominence of geographic segregation in escalating susceptibility to hydropower development (Wang et al., 2018; Liu et al., 2013). Kirchherr & Charles,(2016) illustrates the 21 different impacts as per segment on Table 2.9 of which IDAM is a multidisciplinary model analysis.

Despite the praises of the IDAM (Brown et al., 2009), regarding meeting stakeholder's expectations and transparency about the appraisal system, Kirchherr & Charles (2016), argues that IDAM is not as superior as other models since its methodology is not mature. Also, there is a need for model components to be enhanced (Kirchherr & Charles, 2016).

Table 2. 9: Impacts of the Dam

Socioeconomic impacts	Geopolitical impacts	Biophysical impacts
1. Social cohesion	1. Domestic shock	1. Impact area
2. Cultural knowledge and behavior	2. International institutional resilience	2. Habitat diversity
3. Material culture	3. Political complexity	3. Carbon emission reduction
4. Infrastructure	4. Legal framework	4. Landscape stability
5. Income	5. Domestic governance transparency	5. Sediment modification
6. Wealth	6. Domestic political stability	6. Hydrologic modification
7. Macro impacts	7. International political stability	7. Water quality

Source:(Kirchherr & Charles, 2016)

2.6.3 Multi-Criteria Analysis (MCA)

Liu et al. (2013), Liden and Lyon (2014), Xuehui (2015), and Kumar&Katoch, (2014) elaborates that in hydropower stations there are multi-dimensional perspectives in the appraisal of risks focusing on social –economic and environmental stability. Multi-Criteria Analysis (MCA) has been useful in the evaluation of the sustainability of hydropower projects due to the conflicting objectives caused by compound purposes between social–economic and environmental sustainability. It is very useful in identifying and comparing diverse policy options and diverse alternatives by assessing their effects, performance, impacts, and trade-offs (Vassoney, Mochet, Comoglio, 2017; African Development Bank, 2014).

Research done on the Sri Lankan hydropower projects (Morimoto, 2013), the results indicated that the supply of electricity cost as an economic indicator, resettlements activities as the social indicator, and the environmental indicator was the biodiversity index. Thus, the method explicitly shows the quantitative relationship between the factors (social-economic and environmental effects) of hydropower projects and it takes full control of the trade-off hydropower development objectives (Wojewnik-Filipkowska & Węgrzyn, 2019; Tang et al., 2018). The major advantage of the MCA is that it is used in circumstances where a single-criterion approach like cost-benefit analysis does not manage and where the set of factors cannot assign monetary values (DEFRA, 2003). Hence, it includes financial criteria as well. During the project description and engineering feasibility studies of the Batoka hydropower projects in Zambia finalized under a PPP arrangement (Authority, 2017), layout selection was done with the aid of multi-criteria analysis which looked at ;

a.) evaluation of Environment, Social, Impact Analysis,
b.) Time of construction (expressed in costs), Risks (qualitatively described, including geological, floods, construction, etc.), Least cost of the works,
c.) Flexibility for project implementation and operation (independent power lines, etc.)
d.) Institutional arrangements (power lines separated from the dam)

Singh & Nachtnebel (2016) in support of MCA, recommended the Analytic Hierarchy Process (AHP), due to its flexibility user-friendly, clarity of the results, and the justification given.

2.6.4 Analytic Hierarchy Process (AHP) and Fuzzy Method

As stated earlier sections, in hydropower projects, different types of risks are applicable at different stages and are of different magnitude (World Bank, 2005). These may include; technical risks, political (policy), environmental risks, economic risk, social risk (Messerschmidt, 2008; Panthi, 2007; Shrestha, 2014; ICIMOD, 2011; Agrawala, Raksakulthai, Aalst, Larsen, Smith & Reynolds, 2003; NSC, 2012). Therefore, risk assessment associated with hydropower schemes is an important goal in prioritization research despite the process (Identifying and assessing) being a thought-provoking assignment (Vorachit & Srichetta, 2014). Since the process for mega projects such as HPP/PPP is complex and has limited data available there is a need for the application of more qualitatively expressed indicators, also non-tangible factors need subjective judgment which is critical in proper comparison. Thus, Analytic Hierarch Process (AHP) has been recommended (Vorachit & Srichetta, 2014), due to its power and flexible nature for ranking decision alternatives where decision-makers face multi-criteria situations (Suđić et al., 2017; Y. Zhang, Gu, Shan, Xiao, & Darko, 2018). Since HPP/PPP has several phases characterized by inherent risk factors(J. Li & Zou, 2014), this technique is ideal for managing the amalgamation of quantitative and qualitative risk analysis through a hierarchical structure process (Burger & Hawkesworth, 2011). However, the weakness of the AHP technique is that because of the combined analysis of risk criteria, there are chances of mixing up the process by not clearly defining the positive and negative aspects of the decision (Kasperczyk & Knickel, 2014).

2.6.5 Cases Studies - Analysis of Risk Frameworks

Table 2.10 shows the case studies for some risk frameworks and this author has given out some knowledge gap analysis based on the extensive literature survey conducted by this research. Analysis done in Table 2.10 would be helpful for policymakers, project developers, contracting authorities, and project financing institutions. From the above information provided in this chapter, it is deduced that a well-designed, consistent, and operational risk framework is a key for the successful development and subsequent execution of PPP projects

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Table 2. 10: Analysis of Risk Models used on Various Construction Projects

Study	Project Site	Finding	Gap Analysis	Author/s
Standard Risk Management Framework for Infrastructure Projects	The hydroelectric power plant on the Lower Sava River-Government of the Republic of Slovenia	Project executed on schedule and within the agreed performance parameters as risks were adequately managed using the designed model. The study established that the use of an Ishikawa diagram in the risk management process was a great success as only those risks which were beyond the control of project stakeholders proved to be a nuisance.	-The standard framework was developed for managing risks only at the planning and executing project stages, it did not include the feasibility stage. The framework did not explicitly illustrate the risk allocation for this project. This is cardinal as it enhances the mitigation of the identified risks. The climate change risk identification and analysis in the development of the model were not included.	(Drahansky et al., 2016)
Risk Management Framework of river-type hydropower plants using a fuzzy logic approach	Kulp IV constructed on Dicle River in Diyarbakır in East Anatolia - Turkey	The eleven classes of risk factors (site geology, land use, environmental issues, grid connection, social acceptance, financial, natural hazards, political manipulation, acts of terrorism quality of infrastructure, and market demand were established through interviews, a survey in the field, and literature review. The most significant risks were hydrology, geological structure, and environmental.	The fuzzy logic approach is easily applied by professionals to quantify risk ratings. And the advantage of it is that it gives project stakeholders a leverage platform on which suitable decisions are made with regards to cost, time, and quality. This framework is highly suitable for project developers in forecasting the risk measures in hydropower projects. However, this framework has not clearly stated the risk allocation component. And there is no confirmation if it is applicable at the project development stage (feasibility, planning, and procurement) or it is restricted at the implementation stage. The climate change risk identification and analysis in the development of the model were not included.	(Kucukali, 2011)
A New Risk Management Framework	The framework was applied to the water and ground	Deductive logic was integrated into the designed new risk framework with the ability to identify and mitigate risks transparently and proficiently.	Moreover, the setback of this framework was that it was unable to foster the integration of risk management activities between the stakeholders on	(Kashiwagi & Kashiwagi, 2012)

	infrastructure project estimated value of USD 1 billion in 2008-2012 by the Dutch Agency Rijkswaterstaat. Another project was the Brunsfield Company from Malaysia.	About a 50% reduction in transaction cost was experienced by the government procurement department. Contractors also encountered some reduction in the tendering process by almost the same percentage. Projects experienced early completion of works, it was also established that not only vendors were the source of risks but a lot of contributing factors. The agency (Rijkswaterstaat) has achieved the reduction of transaction cost, enhanced performance parameters, and managed to structure their internal process to achieve value for money.	the project. Also, handling the subjectivity aspect of risk analysis and processing information was a challenge. This research strives to include develop a framework that is highly inclusive such that it would have the ability to incorporate information and strategies during the analysis of the risks.	(Brandsen, 2011; Witteveen, 2011).
A Risk Framework for PPP projects in China -A fuzzy synthetic evaluation approach	PPP projects - China	About 34 risk factors were identified through a literature survey and the Delphi technique brought two more risks. Most risks ranged between moderate and high risk on the construction projects thus, it was deduced that that PPP investment in China's high projects was risky. Political/government intervention risk was among the significant risks including enabling environment and construction risk. Inadequate legal framework and inefficacies in the decision making were also among the major risks attributed to the project delays as analyzed by the model.	Though this framework was developed for PPP projects, it is also applicable to many other traditional methods due to its competence in risk assessment and allocation. The framework is more used on objective evidence analysis than a subjective decision. The climate change risk identification and analysis in the development of the framework was not incorporated.	(Yehoue et al., 2010)
life-cycle risk management framework for PPP	United Kingdom PPPs	The research established that properly identifying and analysis of all risks associated with the whole life cycle of PPP projects is very essential. This attributes to risk minimization and elimination for	This research centred on the general PPP infrastructure projects. Efficient risk allocation and monitoring were among the salient feature exhibited by this framework. The research	(Zou et al., 2008a)

infrastructure projects		enhancement of project success. The framework pointed out the importance of balanced interest among the stakeholders on a PPP project for the achievement of value for money and sustainability.	recommended that the risk framework must be applied at the project development stage and throughout the remaining project life cycle stages. This was the limitation component of this framework. This author agrees with(Zou et al., 2008a), as this is the best way of achieving value for money which subsequently benefits all stakeholders.	
Risk Allocation and VFM Frameworks in Construction PPP Projects in the United Kingdom	In Various Construction PPP Projects	Two significant findings from this study reflected that most risks are allocated to the private sector. The other component of the findings was that proficient risk allocation, well-defined specifications, and properly negotiated contractual agreements were echoed as the most critical success factors of PPP projects.	This framework is inclusive of very cardinal project management components. It incorporated the measurement of performance parameters, project sustainability, and best practice procurement techniques to fully achieve PPP project success. It is straightforward and focused as once appropriately used, it has the potential to effectively contribute to proficient risk allocation and reduction in processing time. However, the framework has not given clarity on the risk identification component, it stresses more on the analysis and allocation. This research strives to develop a framework with the capability of identifying, analyzing, and risk allocation to the party with the capacity to handle them. The framework also intends to show the connection of value for money and sustainability to the independent and moderating variables.	(B. Li et al., 2001b)(B. Li et al., 2001b)

Compiled by Author (2019)

2.7 Technical Inputs in Risk Management Framework

The research reviewed various risk management frameworks and deduced some critical factors which must form part of the risk management framework. These are elucidated below;

2.7.1 Expert Judgment

Hora (2009), is referred to as looking at the data presented with impartiality and making an objective decision that can be sustained. It entails bringing in efficacious technical experts to make a decision using various techniques and acquired knowledge on the related matters (Hora, 2009). Determining the objectives of the project is influenced by an expert judgment process as the first step (Issa et al., 2012; Beaudrie, Kandlikar, & Ramachandran, 2016). Thereafter, a criterion is designed for the identification of experts and one of the most prerequisites is that the experts must have a very good understanding of the relevant data, modelling, or profiling of the situation and legal framework surrounding the project (Osei-Kyei et al., 2017). This process (use of experts) is known as a Delphi technique (Awodele, 2012; Anvuur & Kumaraswamy, 2006; Kibler, K., D. Tullos, B. Tilt, A. Wolf, D. Magee, E. Foster-Moore, 2012; Kurniawan et al., 2015). It is very critical in the development of a risk management framework for tackling various challenges for the enhancement of successful outcomes (Aggarwal et al., 2016). However, (Lamas et al., 2014), argue that even with the use of experts in the input for risk management framework development, the risks encountered in the development which sometimes affect the expected outcome is not eliminated, only mitigated by good management.

2.7.2 Framework Documentation

These are critical technical information, prepared in a novel way by stakeholders that must be fully understood and interpreted into multi variables. Further, the outside groups evaluating the decision process such as regulators, financers and the legal team needs to be engaged on the relevant documentation(risk register, significant risks, business case, bankable documents) developed to appreciate and sanction the projects (Effah Ernest Ameyaw et al., 2016). Accenture (2015), emphasized that for the risk framework to be appreciated, validation of technical tools, operating procedures and documentation must have the input of all stakeholders.

2.7.3 Policies and Procedures

Anvuur & Kumaraswamy (2006)**,** states that policies and procedures define the strategy and operation of the project to achieve its objectives. This echoed by (Adam, 2019), that top management on the project must be active in the support of best practice operative guidelines and implementation of frameworks in line with the legal framework to achieve good governance (Lamas et al., 2014). While, Jordan-Tank & Garcia (2016), deduces that guidelines and procedures are in line with recognized international best practices that promote standardization, create an environment of the achievement of efficiencies and ultimately, enhancement of the achievement of Value for Money. Hence, this researcher attempts to incorporate the legal framework surrounding the PPP projects in Zambia. This includes the PPP Act, Policies, Zambia Pubic Procurement Act, and the involvement of relevant institution such as National Council of Construction, Engineering Institute of Zambia, Ministry of Finance and National Planning, Ministry of Energy and Ministry of Infrastructure.

2.7.4 Roles and Responsibilities

Ruiz (2015), states that in a Comprehensive Risk Management Framework, to achieve proper project governance, there is a need for a policy to define the roles & responsibilities of the partners. Risk mitigation is based on effective risk allocation to the party with the wealthy and the capacity to handle it. Hence, the definition of roles and responsibilities is critical. In the absence of a cohesive framework in governing the mandate of the institutions (Official et al., 2019), responsibilities, and lack of proper procedures in making decisions presents a challenging platform for PPP investors. Some of the success factors of enabling environment for PPPs are collaborations among the stakeholders on critical areas of the project, financial and technical commitment, responsibility-sharing, costs, and benefits (Yakubu & A. Anigbogu, 2016a).

PPP projects which failed in Liberia and the Sudan states were worsened by the weakness of the disclosure requirements, segregation of responsibilities, and poor accountability of the key stakeholder (S. O. Kodongo, 2015). As much as there has been some attempt to have the proper allocation of responsibilities and roles, there are still cases of project failures (Zack et al., 2009). This research agrees with Cameron et al., (2017), that obligation, effective communication, collaboration, political will and support, schedule of roles and responsibilities are some of the critical success factors of project success. Corporate governance is yielded with a proper schedule of responsibilities and a well-designed risk framework (Deep, Kim, & Lee, 2019; Parker et al., 2018; Gupta & Singh, 2018; Minnie et al., 2011). Also, for the framework to function efficiently and effectively, top management must be actively engaged in its development. the literature survey (Hofer & Juric, 2001; Anvuur & Kumaraswamy, 2006; Adam, 2019).

2.8 Summary of Literature Review

This research was centred on the hydropower projects finalized through PPP and how a well-designed risk management framework could contribute to project success and meet the demand for renewable energy. However, Lumbroso et al., (2014) state this type of project face several inherent risks exacerbated by climate change and other environmental factors (Harrison and Whittington, 2001). It is this risk appetite that has led to hydropower project sponsors and executors develop framework/models that can attribute to the identification of risks, analysis, and devise effective risk allocation techniques. This literature review established that there is a significant gap between the need for energy and the existing financial, technical, and managerial capacities to achieve sustainable hydropower development in many developing nations. And these projects have inherent risks which must be managed systematically.

Risk identification comes first, followed by risk analysis through the use of various techniques. The methods of risk identification need to be suitable and appropriate for the particular project to mitigate the risk of missing out on important risks. The analysis of the identified risks provides a platform to understand the significance of the risks. This enables the prioritization and ranking of the risks in terms of probability of occurrence and impact on the project objectives. Finally, the technical inputs into the framework development are critical as the function of the framework is highly dependent on them. Thus, the research deduces that in the development of a risk management framework, the processes share information and depend on various variables.

Having traversed around the literature survey, this author infers that risk management in such huge projects like HPP/PPP requires consented effort from all the relevant stakeholders. The project environment, legal framework, institutional capacity, and the efficacy of the private sector experience coming on board plays a crucial role. This author has come across several risk frameworks/models but most of them lack the crucial components which this research strived to develop and most models are not specific on which project stage they are applicable. Therefore, a hybrid framework was developed specifically designed for the project development stage – feasibility, planning, and procurement. This is underpinned by the literature survey which established that having a well-designed risk framework at the project development stage is cardinal as the success of the project is enhanced with the minimization of the risks that are severe to the project.

Table 2.11 briefly presents an overall knowledge gap analysis regarding some research conducted concerning HPP/PPP and the various legal framework surrounding the PPP governance in some countries. The table may not be exhaustive as, during the development of this chapter, this author has brought out some critical knowledge gap analysis, remarks, and critical success factors confirming the adequacy coverage of it for the chapter meeting the minimum requirements for academic writing.

Table 2. 11: Overall Knowledge Gap Analysis

Table 2. 10: Summary of Knowledge Gap Analysis on some selected author/s

Topic	Findings	Methodology	Gap Analysis	Author/s and Year of Publication
"Reasons for delay in selected hydropower projects in Khyber Pakhtunkhwa (KPK), Pakistan".	The projects were delayed by over 200% of the initially estimated duration. This was attributed to the absence of political will and regulatory framework, construction delays, poor project financing, futile feasibility studies, and poor project planning and integration techniques. The projects also incurred costs over the run of about two and a half times the estimated project costs.	A literature survey and preliminary interviews from experts were used to collect qualitative data. NVivo software was applied in the analysis of qualitative data. The questionnaire survey was designed and for factor ranking of the failure reasons, the relative index was used. Consultants, contractors, and clients were the respondents, thus, the ranking attached to each respondent was in terms of frequency index, severity index, and relative importance index. The correlation coefficient and Cronbach's alpha (reliability test) technique was used to measure the correlation on the rankings among the parties and internal consistency respectively.	The philosophy adopted was pragmatic and the research design was exploratory mixed-method design though this was not mentioned. This author has deduced because both qualitative and quantitative data were applied in the analysis of data. It is cardinal to highlight the philosophy and research design for the reader's clarity. These projects suffered several risks due to a lack of proper project management techniques. There is no mention of the risk management framework/model to enhance project success and minimize the risks incurred. If the value for money and sustainability of the infrastructure were known and expected, project stakeholders should have strived to ensure risks were managed well.	(Batool & Abbas, 2017b)

"Managing risks of the Grand Ethiopian Renaissance Dam on Egypt-GERD".	Among other risks, this research objective was to provide mitigation measures caused by the hydro project dam (GERD). Mitigation measures included; Elimination of agro plants that consume too much water such as rice; the Irrigation system in improvement through the introduction of pipes to save water losses and the introduction of some innovations such as drips and the use of sprinklers. All these technical and innovative were introduced to save water losses due to evaporation and loss avenues as hydrological risk (insufficient water) was eminent.	The research approach used was both qualitative and quantitative techniques. The research design was as follows; identification of the risks was by brainstorming technique while for analysis Delphi Technique was applied. The first two processes were qualitative. Finally, the risk magnitude was established quantitatively through the application of Expected Value (EV) analysis.	The study concentrated more on the hydrological risk (insufficient water) and prominent risks on this project such as geopolitical and country risks have not been mentioned. Several mitigation measures were suggested for the hydrological risks, however, the framework or road map to identify, manage these risks/challenges were not mentioned in this research. Thus, this author strives to develop a comprehensive risk management framework specifically for the project development stage to manage the risks which can attribute to the delays or failure of the hydropower projects. The risks encountered in this GERD project could have been minimized or eliminated at the project development stage with a well-designed risk model.	(El-nashar & Elyamany, 2017)
"Zambia's Infrastructure Public-Private Partnerships Policy: Steps to Strengthen the Framework"	The PPP is adequate but there is a lack of institutional capacity to effectively follow the ACT guidelines to implement the projects and a lack of political will and support from the government. The lack of transparency and accountability in the PPP procurement progression. The Zambian PPP framework lacks detailed procedures and operational guidelines compared to some successful examples such as the	Interviews with experts and literature review	Several challenges have been cited and some strategic recommendations but there is no mention of how to specifically manage the risks associated with PPP. Though the authors stated that the handling of feasibility studies is a challenge in Zambia, the planning stage was left out as it is very critical in the execution of the PPP projects. The paper stresses more effort on the Transport sector for Zambia, but the PPP legal framework caters to various sectors.	(Anyan et al.,2016)

	United Kingdom, Germany, and South Africa. The business environment is characterized by bureaucratic tendencies and not a streamlined registration process. Poor coordination and lack of support from the public sector regarding feasibility studies.			
"Risks Associated with Infrastructure Public Finance in Developing Countries – The Case of Zambia"	The cancellations of some PPP projects were due to procurement improprieties. Specific risks like skills in the public sector to structure project finance projects, procurement process and support by the Ministry of Finance ranked generally high. Political violence, law, and order rank as one of the lowest risks in Zambia.	Literature survey, Questionnaires, In-depth Interviews. For risk analysis, the mean score technique was used.	Generalized risks are inherent in Infrastructure PPP projects. The risks must be categorized and cited as per the stage of the project cycle. The author has not outlined how the risks were identified. The technique for risk analysis applied to this paper needed to be stated whether it is qualitative or quantitative. Sectors such as Energy, Transport, Agricultural, and ICT have their inherent risks though some risks may be found in all the sectors. Hence, it is cardinal that this is mentioned during the risk management process.	(Mweemba,2014)
"A Case Study of Bujagali Hydropower Public Private Partnership Project Between Uganda Government and	Project delay commencement was encountered due to stakeholders contesting through local and international environmental institutions concerning the change in hydrology, ecological issues, resettlement, and cultural factors.	Secondary data was collected from various literature, observations on the ongoing similar PPP projects.	There was no adequate stakeholder's engagement by the public partner at both local and international levels to enhance the minimization of the most risks encountered. There was no solid risk management process and no mention of the use of the designed risk management framework/model with clear	(Kabanda,2014)

Bujagali Energy Ltd in Electricity Generation in Africa"	Despite the project delay, the electricity tariff was overpriced. 250 MW was the projected generation capacity, but this was not attained due to inadequate water to sustain the generation process owing to low water levels of lake Victoria. There was some overestimation of the benefits with regards to social-economic activities and relaxation on the critical risks such as a change in the hydrological structure. Finally, the resettlement plan of the people was poorly assessed and highly affected the spiritual activities of the local people.		accountability and appreciation of the inherent risks associated with hydropower projects. As the risk framework/ model could have aided the identification, qualitative & quantitative analysis of the risks identified. Thereafter, the model could aid in the location of the risks to either private or public parties.	

Compiled by the Author (2019)

In addition to the number of knowledge gaps that have been highlighted. However, this author has potted them into two pinpoint gaps;

Epistemological gap - this is attributed to different understandings of which types of knowledge are relevant and should be managed. HPP/PPP are complex projects with various experts drawn from engineering, science, policy and environment which provides a platform for different interests and worldviews when it comes to the very conception of risk management knowledge and applicability. This gap is exacerbated by the contractual complexities rooted in HPP/PPP. The experts (engineers. Scientists, policymakers and project developers) perceive matters from different views that need to be reconciled because stakeholders possess different epistemic cultures. The public and the private sector are prone to misconstrue with regards to natural sciences, social sciences, humanities, and geography, sociology, climatology, hydrology, meteorology, legal science, among others that seldom enter into dialogue and interdisciplinary problem-solving.

A well elaborative guideline or road map upon which stakeholders can better communicate complicated material around the pressing matters inherent in HPP/PPP is needed. This can be done through the use of mediators, finding new ways of communicating complex issues incomprehensible ways, and engaging project officers with both theoretical and hands-on experience with hydropower projects finalized through PPP.

The Institutional Gap - The risk management culture should not just be for the individuals participating in the project but there should be equally about governance and institutional building. The barriers to poor risk management culture can be directly traced to the lack of innovative plans by the new and existing institutions to successfully mitigate some inherent risks.

2.9 Chapter Summary

In this chapter, a variety of literature from different scholars was reviewed. The literature survey attempted to search on projects which have been implemented by several governments and international agencies worldwide. The emphasis was on the need to intensify the thorough management of inherent risks on the various project life cycle stages. From the literature, it can be deduced that risks shall continue negatively impacting the HPP/PPP unless a robust risk management system is embraced. Risk management if not integrated into any complex projects, the achieving of the intended output and outcomes is compromised. Appreciation and application of the relevant technology in the systematic management of risk are vital for the enhancement of obtaining value for money and sustainability of projects.

Several knowledge gaps on the methodology, risk management tools and techniques, important variables to enhance project success were established. This research endeavours to close on the identified knowledge gaps in the next chapter. The next chapter is part B of the literature review on the PPP concepts, operationalization of the same, and its value for money, and sustainability in terms of environment, economy and community.

CHAPTER THREE

PUBLIC-PRIVATE PARTNERSHIP VS TRADITIONAL PROCUREMENT

3.1 Introduction

The second part of the literature review was on the PPP concepts, operationalization of the same, and the comparison of PPP procurement with the traditional procurement method and various types of PPP. Project Finance of Hydro Power Projects (HPP) was equally fully analyzed and the role played by various financing institutions, World Bank including cooperating partner. Subsequently, Value for Money and Sustainability on PPP projects have been elucidated.

3.2 Overview Conceptual outlook of Public-Private Partnership (PPP) at Global Perspective

OECD (2008) clearly explains PPP as *"an agreement between the government and one or more private sector partners (which may include the operators and the financers) according to which the private partners deliver the service in such a manner that the service delivery objectives of the government are aligned with the profit objectives of the private partners and where the effectiveness of the alignment depends on a sufficient transfer of risk to the private partners".* Just from the highly elaborative definition of PPP, it opens up space for potential challenges that can be faced if there is no proper risk management system in the handling of these complex projects.

Governments all over the world are desperately developing financing mechanisms in infrastructure development projects, that involve collaborating with the private sectors to enhance the high level of economic investment (Mishra, 2016) and development (Ong'olo & Spellman & Walker Co. Ltd, 2006). There is impressive evidence of established and use of PPP models with varying degrees of implementation in the Republic of Korea, China, India, Indonesia, the Philippines, Singapore, Latin America, and the Caribbean countries since the late 1980s (Lee et al., 2018a). Brazil, Colombia, and Peru have an extensive track record on PPP projects while Chile and Mexico have implemented the most successful PPP projects (transportation) in the region (World Bank 2017). This research attempts to get the knowledge gap on why PPP is successful in certain circumstances and failures in other regions.

Lee et al., (2018) state that PPPs bring on board innovative techniques on how the public and private sectors collaborate to deliver public infrastructure and services. The PPP has proved to be a ground-breaking policy tool in improving the performance of the public sector by reducing government budgetary constraints (Jamali, 2004). This is achieved by the use of private capital for infrastructure investments (Jamali, 2004). Due to the long duration of the contractual agreements between the parties (private and public), officials in charge of finalizing these agreements must be well vested with the standard practice to mitigate the risks associated with long term contracts. Partnerships (2018) assert that in the European Union, from the 1990s to about 2017, a total of 1749 PPPs valued at 336 billion euro reached the financial close of which most projects were implemented in the field of transport. This investment in 2016 accounted for one-third of the entire year's investment, ahead of healthcare and education (Partnerships, 2018). The author continues that among the 12 European Union's co-financed PPP projects in France, Greece, Ireland, and Spain in the fields of road transport and Information & Communication Technology (ICT), about 70 % of the total project cost of 29.2 billion Euros were executed through PPP procurement models. France, Ireland and Spain are stable and developed nations that are implementing their projects through PPPs, this research attempts to find why some developing nations are still stuck to traditional method despite budget constraints and lack of technical expertise compared to the developed nations in Europe and other continents which have embraced this phenomenon.

3.2.1 Public-Private Partnership Model

Delmon (2009) and Sulzer (2018) explains the generic outlook of PPP models as the client, which is a government agency through the Contracting Authority, gets into a concession with the concessionaire. The concessionaire is referred to as the private sector syndicate in this case. The role of the private sector includes project financing, designing, and provision of the product or services in the identified sector. Thereafter, the private sector operates the project for a quantified period, known as the concession period (fixed or variable). At the end of the agreed period, the project must be transferred to the government agency without any charges. This entails, there should be a lot of effective negotiations before finalizing such contractual obligations(Mayer, Juice-Elena (Wie) Yusuf, & O'Connell, 2019). The concessionaire manages the revenue produced by the project to carry out repayment of financing and investment costs as well as managing the operational costs without getting into the project profit margin during the concession period. However, the government must ensure there is a demand for the services/products at a reasonable and justifiable price including the cost to end-users.

The government benefits from this deal as there is the provision of adequate infrastructure to meet its national demands and reduces borrowing since the private provides the funds for the projects (Delmon, 2009; Sulser, 2018). Nevertheless, the PPP projects are not always perfectly executed as there are some renegotiations, cancellations, or abandonment of work that arise during the project execution(Yang et al., 2010). The results are high project costs, loss of business confidence, loss of trustworthiness among stakeholders, project resentment, and stakeholders blocking the project (Guasch et al. 2014). The stated challenges technically denoted as risks that affect project success justify the need for effective risk identification at the project development stage such that if the costs outweigh the benefits, the project can be considered for cancellation or undergo some foremost modifications during the initial planning stage (Sarvari et al., 2019). Risk identification at the project development stage is highly recommended (Maqbool and Rashid, 2017). The reason attributed to this is that the severity of impact on the project outcome is minimized and technically the cost of making changes at the initial stage of the project life cycle is less compared to other progressive stages.

Figure 3.1 illustrates a typical PPP concept. It has been adopted from Attarzadeh (2014). The private sector's apprehension on a PPP model is the financial viability. Their concern is that the business deal creates investment opportunities with high returns to cover the project financing and funding (Chou & Pramudawardhani, 2015) and including the amortization of debts with no difficulties(Okonkwo & Okolo, 2014; Dunn, 2017). While the public sector is to ensure that there is an enabling environment (Lumbroso, Hurford, Winpenny, & Wade, 2014:Johnston, 2016) and proper legal framework (Ke et al., 2011) so that there is project success (Wet, 2016; Shuibo Zhang, Gao, Feng, & Sun, 2015), an achievement for Value for Money (Burger & Hawkesworth, 2011; Almarri et al., 2017) and sustainability (Charoenngam & Kurniawan, 2015; Bain, 2009).

According to Attarzadeh, (2014), PPP models are complicated as seen from the concept above (see figure 3.0) due to several physiognomies compared to traditional project procurement methods. Some of the identified features are as follows;

(i) The development period is lengthier and costly. In some cases, years elapse before the feasibility, planning, and procurement stage is finalized.

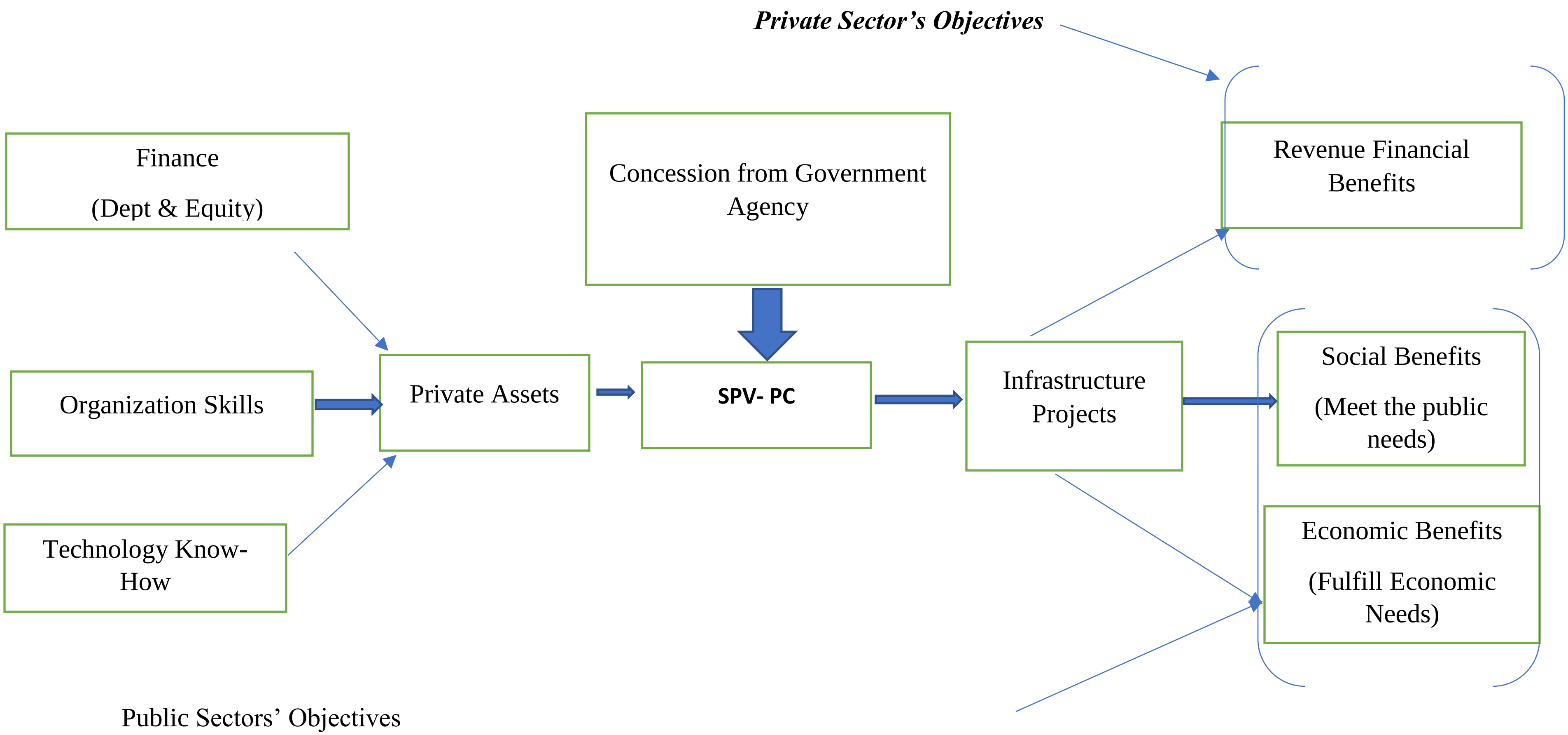

Figure 3. 1:The PPP Concept -Source: Attarzadeh (2014).

(ii) The contractual arrangements and negotiations are more complex compared to the traditional method. Romero (2017) reports that in Tanzania, the PPP agreement between TANESO the state-owned electricity company, and Independent Power Tanzania Limited (IPTL) was highly detested due to the cost and projected demand for power. It was characterized by corruption allegations involving government officials and planning problems. No appropriate feasibility study was undertaken to ascertain the problem was not lying with insufficient generating capacity, but a lack of gridlines.

(iii) Financial viability, Project Financing, and Return on Investment are the key components considered by the private sector before entering any negotiations.

3.2.2 PPP Procurement Vs Traditional Public Procurement

There is a need to appreciate that the benefits of PPP are only achieved when the contract has been appropriately drafted and well negotiated optimal risk allocation between both public and private actors (Dunn, 2017). Table 3.1 provides briefly illustrates the differences between PPP procurement and conventional procurement methods

Table 3.1: Key features Distinguishing Public Private Partnership from Conventional Procurement

P3 Procurement Model	**Convention Procurement Model**	**Comparative Advantage of P3 Model**
Output-based contracts	Input based contracts	Promotes private sector *innovation* in building public infrastructure
Mostly of fully private financing	Mostly or fully public financing	Transfers *investment* risks from taxpayers to the private sector
Conditional payments based on delivery	Regular payments in intervals	Gives *incentives* to the private sector to work both on time and budget
Integration of two or more projects phases (i.e. design, build, operation, and or maintenance)	Project phases contracted separated (i.e. design, build, operation, and or maintenance)	Transfers Projects risks from taxpayers to the private sector; this ensures *accountability*.
Project Management by Private Sector	Project Management by Public Sector	Utilizes Private Sector's *expertise* in specialized fields

Source:(Dunn, 2017)

> *"PPPs are not always more efficient than traditional procurements. Only if the contracts and implementation of PPPs are well designed, then the efficiency of these partnerships can be enhanced. Concerning the PPP model for the Republic of Korea, the results are similar to those from a traditional procurement, rather than to an ideal PPP. This shows that contractors only focus on maximizing short-term profits by minimizing construction costs rather than maximizing overall profit from the whole cycle of the project. Should a government promote PPPs as an alternative to traditional procurement to enhance efficiency, it needs to make the PPP mechanism as close as possible to the ideal model of a PPP. From the Republic of Korea's perspective, the incentive structure of construction companies, which only care about minimizing cost but not maximizing the overall net benefit of a project, needs to be changed. The good way of going about this would be to strengthen competition in PPP markets."*

This is what the research steered by Lee and Kim (2018) on traditional procurement versus PPPs with assistance from the Asian Development Bank reviewed.

This is evidence that traditional public procurement is still being widely used globally despite the promotion of developing infrastructure through PPP (ibid, 2018). In the United Kingdom, despite having a well-designed Private Finance Initiative, Davies and Eustice (2005) observed that 85% of public investment is delivered through traditional procurement. Davies and Eustice (2005) indicate that under traditional procurement, the public sector is responsible for raising the project finance, takes charge of the operating cost, responsible for project delays and cost overruns if incurred. But, in PPPs, the private sector raises capital through debt and equity, while operating costs and revenue are raised from the quality of the service provided by the infrastructure.

Checherita and Gifford (2007) observe that since the partners on the PPP model may have different stakeholders or the same, their perception of the inherent risks may be different. However, Jasiukevicius, (2018) and many scholars have argued that despite the easy project financing exhibited by the PPPs, in the long run, public accounting is affected by some future payment towards this model and has the possibility of affecting sustainability (Benito et al., 2008; Grubišić

Seba et al., 2014; Morales et al., 2013). From the arguments presented by various researchers on PPP, this author depicts some risks such as contractual, stakeholder's perceptive, and financial risks that must be identified early enough, analysed, and allocated to the party with the wealthy to handle them through the aid of well-designed risk management model. Figure 3.2 supplements the differences highlighted by (Dunn, 2017) between traditional public procurement and the PPP delivery system.

Comparison of Traditional Method and PPP

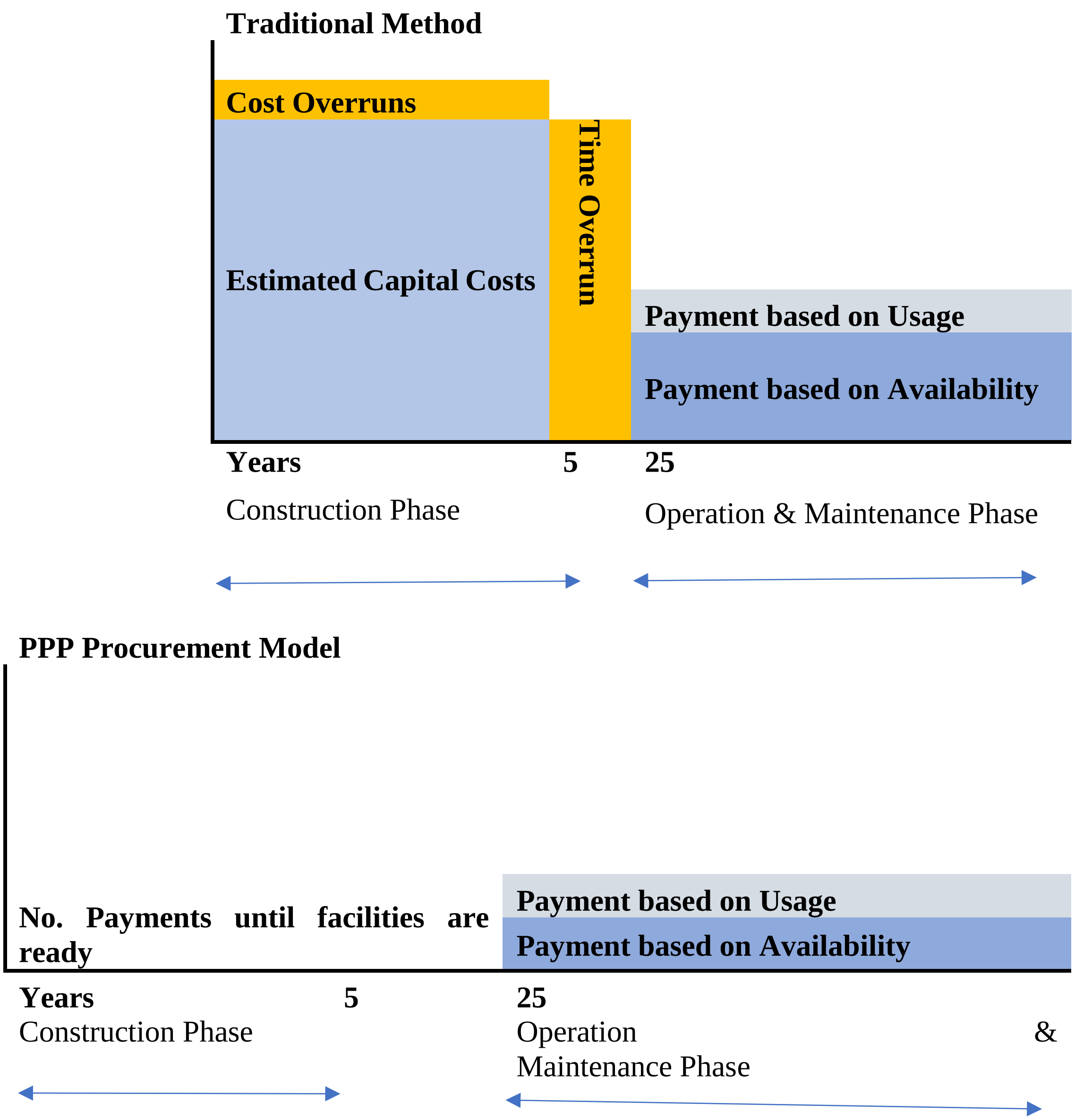

Figure 3. 2: Comparison of Traditional Method and PPP Source*: Davies and Eustice (2005)*

3.2.2.1 PPP Procurement Variants

Shaibu (2018), explains that a BOT contract which is referred to as Build Operate Transfer (BOT) is a model used in financing large Greenfield infrastructure projects in PPP. In this contract model, the private partner provides the finance to build the project and operate it to get their return on investment for the agreed period (concession) before handing it over to the government (Kashef, 2011; Nourzad, 2009; Menheere and Pollalis, 1996). Does this raise questions that at what state is the infrastructure handed over to the public sector to run effectively? What clauses must be enshrined in the concession agreement to ensure that the private sector maintains the infrastructure during its operations? What is the best practice to achieve a win-win solution? These questions have been tackled by ensuring all the risks are identified at the project development stage and the risk model to ensure there is the monitoring of the reoccurring risks which can put the public sector in a disadvantaged position. Only if this risk management is efficient that the achieving of VfM and sustainability can be attained.

However, there are other forms of BOT. Table 3.2 explains some of the commonly used variants on various PPP projects around the world.

Table 3. 2: Some of the PPP Procurement Variants

Financing Model	Description	Project Name	Remarks/Critic	Source/Author
Design-Build (DB) or Turnkey Contract	The infrastructure is designed and built by the private sector in meeting the agreed performance specifications at an agreed fixed contract price and duration. Project delays, technical, quality, and cost overrun risks are allocated to the private sector. **Significant Risks identified**: Failure to meet performance standards, Untested engineering practices. There are chances of reduced owner control.	Development of 1071.43 MW combined-cycle power plant by Tenaga Nasional Berhad ("TNB") in Malaysia; A turnkey EPC contract for the power plant by Wärtsilä in Kenya.	It allows the overlap of designing and construction leading to project delivery time reduction. However, the quality of the works may be compromised if the client is not technically competent to guarantee the anticipated designed specifications.	(Sulser, 2018; European Investment Bank, 2011; Judith Plummer Braeckman, 2008; Akrm & Alwahab, 2015; Nurul et al., n.d.; Yescombe, 2017; Lau Siew Soon, 2012)
Service Provision Contract	The asset or facility owned by the public sector is operated by the private sector under a contractual agreement for a certain period. The asset remains public property. It calls for abilities to manage multiple contracts and a strong understanding of contract laws **Significant Risks identified:** Demand risk**,** poor reception by the public	The Maldives government signed PPP contracts in Transport, real estate, electricity, water, and sanitation.	These contracts are easily terminated than regular workers minimizing employment claims and lawsuits. However, the management authority is weakened regarding the quality of the service.	(Charoenngam & Kurniawan, 2015;L. Tshombe & Molokwane, 2016);
Affermage/Lease and Operate Contract	The private party signs a contract with the public sector to manage and operate the government facility on agreed fixed terms. The operator is responsible for the operation, revenue collection (user charges) and maintenance of the facility **Risks identified**: Demand risk, operation, and commercial risk, regulation. Possible skirmishes	Water and Sewerage utility projects in Cote d'Ivoire, Cameroon, and Senegal; Small-scale water sector, Uganda; SPEN project in Niger	Though these contracts are easily implemented in other PPP financing models, most private investors are discouraged from return on investment. Also, most risks are borne by the public sector and it is mostly applicable to existing infrastructure	(Lau Siew Soon, 2012);(L. Tshombe & Molokwane, 2016);(Sulser, 2018);(Akrm & Alwahab, 2015);(Bracey & Moldovan, n.d.)

	between the public body responsible for investments and the private operator.		assets which may be old with a lot of operational challenges.	
Management Contract	A private party is assigned several government tasks that are supposed to be delivered by them. This may include maintenance of public amenities such as parks, roads, prisons, weighbridge operation, management of traffic, provision of security surveillance, and many more. The fixed rate is agreed with the public authority for the services rendered.		It relieves the pressure on the client to handle other competing operations however, the success of this model depends on the depth of contractual understanding by both parties to draw the performance parameters and payment terms.	(World Bank Group, 2009)
Build-Operate-Transfer	The private party is in charge of designing, constructing, upgrading, or rehabilitation of the public facility. The mobilization of the project financing is in the public party's scope. Upon completion of the project, it is then operated by the private sector and collects the user fees or tariffs which forms part of their payment, amortization of the loans, and maintenance of the facility during the agreed period. The facility is then given back to the public authority for operation after the elapse of the concession period. The facility legally remains in public ownership throughout the contract. **Significant Risks identified**: Long tendering procedures, require strong institution capacity, Political barriers, resistance by both parties (government departments, and private sponsors).	Ilijan Combined-Cycle Power Plant built-in Philippine, Electric Power projects in China, Kasumbalesa One-stop Border Post; Luburma Market Project; Incineration Services Agreement (ISA) with the Keppel Seghers Tuas Waste-to-Energy Plant Pte Ltd; New Cairo wastewater plant, Egypt	The public cost is minimized on infrastructure development coupled with the introduction of innovation, thus reducing public debt. It allows for innovation. Conversely, it presents high transaction costs. It also requires sufficient operation revenue for the achievement of return on investments. It equally calls for strong corporate governance and institutional capacity in handling PPP projects.	(Thiemann, M., & Volberding, 2017);(Kurniawan, 2013); (Awodele, 2012);(Roman, 2015); (Shaibu, 2018);(Shen et al., 2016)

DBFO-Design Build Finance and Operate	The private party designs, builds, operates and finances a public facility for a defined period. After an agreed period, the facility is given back to the government. The private party recovers cost through public payment. The key issue is the mobilization of project financing by the private sector and the transfer of design, construction, and operating risk to them. However, their various forms that involve different combinations of principal responsibilities. **Significant Risks Identified:** Conflicts during planning, long tendering procedures, the complexity of the contracts, it requires proper contract management and performance monitoring systems required, cost of taking up operations if the operator demonstrates substandard.		Most risks are allocated to the private sector but the process is so complicated that there is a need for expertise and a deep understanding of project management techniques to enhance performance success. A well-designed risk management model is a must to ensure effective identification and analysis of risks due to several inherent risks.	(European Commission, 2003);(Kurniawan, 2013);(Yakubu & A. Anigbogu, 2016b);(Saiyed, 2015);(Adamu et al., 2015);(Akintoye & Beck, 2009)

Compiled by Author (2019)

Table 3.2 presented some of the PPP variants commonly used in mega infrastructure development and their significant risks. This author has also provided remarks and critics based on the literature survey.

3.2.3 Challenges of Public-Private Partnership

Akrm & Alwahab (2015), argues that even though PPPs are known for many benefits in a win-win situation, some PPP on energy infrastructure projects faces challenges such as bankruptcy of the private sector, uneven contractual agreements, corruption, delays and economic risks such as inflation or exchange rates attributed by external factors leading to threats on the viability of projects. Other cited problems include unwieldy legal and planning frameworks applicable to PPPs (Nguyen, 2017), undefined institutional roles for project planning and implementation (Valentine, 2008), lack of sound project selection (Kodongo, 2015) and preparation processes (Tolani, 2013a). Additional challenges include; tariff setting is not conducive to PPP projects as pricing methods are insufficient for cost recovery (Bank, 2012) and information asymmetries between the public and the private sector leading to unfair contractual negotiations (McQuaid, 2019).

The budget deficit, technical incompetence, corruption, inappropriate costing, and inadequacy in the provision of poor quality services is what has led the shifting to the private sector for financing, construction, and operation of a large infrastructure project (Attarzadeh, 2014; Shediac, Hammami, Abouchakra, & Najjar, 2008; Alfen & Wilhelm, 2009). But how effective and transparent are PPPs procurement models not to face the similar problems faced in the traditional method? And what can be done to enhance energy infrastructure development through PPP? This research looks at various PPPs that have been implemented in the energy sector by identifying the positive and negative risks which were and are being encountered.

This author raises questions such as; what is the point of promoting PPPs when there are several challenges mentioned? At what price does the public sector pay for infrastructure projects through PPP in comparison to the traditional method? Can effective identifying, analyzing and allocation of risks on these complex projects lead to project success at the development stage? What are the technical tools and techniques used in the risk management process? What role can the public sector play to ensure that such huge projects achieve Value for Money and sustainability? And, finally, what role do the legal framework and policies play in PPP agreements? These questions are fully tackled in this chapter and the proceeding chapters.

3.4 Operationalization of PPP Concepts and Risk Management Process

PPP sector business is an embryonic concept that has taken many forms in at globe perceptive, it has been growing at a rapid rate in terms of being used as means of procuring infrastructure assets and their related services, gesturing a fundamental shift in the relationship between the governments and the industry (Olusola, Oluwatosin, and Rufus 2016; Akintoye et al., 1999). This phenomenon has been adequately used in the United Kingdom (UK) and it is broadly branded as Private Finance Initiatives (Adetola et al., 2011; Ke, Wang, Chan, and Cheung, 2009; Deloitte, 2006). Olusola et al., (2016) agree that in the UK, Private Financing Initiative is underpinned by a well-developed institutional, legal, and regulatory framework including the relevant commercial edifices to support this procurement strategy.

Some developed nations which have encompassed PPP procurements strategy include Ireland, Germany, United States, Hong Kong, Australia, Spain, South Korea, Canada, Japan, France, Iran, Singapore, China, and Brazil (Adetola et al., 2011; Brook; 2001; Chan et al., 2009; Daube et al., 2008; Deloitte, 2006; Hamilton, 2001; Kouvarakis, 2001; Noorzai et al., 2016). Developing nations also in line with the promotion of this strategy are South Africa, Nigeria, Cameroun (Li and Zou 2014; Olusola, Oluwatosin, and Rufus 2016) have managed to develop several infrastructures. This new approach has attributed to more efficient and more transparent government business operations (Velotti et al., 2012), implementing incentives and managerial techniques of the private sector, including private sector participation in domains that used to be held by public monopolies (Bruchez, 2014). There have been a number of both successful and failed PPP infrastructure development projects (Yescombe, 2017), and recorded failed projects have negatively affected development. A well-designed risk management model is envisaged to reduce the failure rate of PPPs.

Yescombe (2017) enlightens the PPP concept by demonstrating that PPP projects are perceived as complex to procure in comparison to public procurement. The complexity component creeps in because the procurement covers not only the project execution component but also its operation and maintenance after the project is completed and commissioned (Pilcher 1985; Mudi 2016). Since it caters beyond the project life cycle, the requirements of project developers and project financers are taken into consideration to broadening the complexity of the projects. The author nails it that due to the time spent on structuring the PPP during the project development stage, it is the main reason why most projects are successful (Yescombe, 2017). However, there are several failed projects as well, of which a risk management model could be superlative at the early stage of the project (Project Development Stage).

The government's competence levels, efficient appropriateness in the selection of the concessionaire, well-designed risk allocation between the public and private sectors, and sound financial set (Project Finance and Project Funding) are among the determinates of PPP project success (Kwak et al., 2009). Ineffective risk allocation between the government and private sector and poor monitoring techniques of the private participants is what led to the glitches of the London Underground PPPs anomalies (Kwak et al.,2009). Henceforth, this author strives to critically understand the PPP concepts by identifying the conditions on which PPPs create win-win situations, identification of the risks, critically analyzing risk management techniques used on various PPP projects. Furthermore, seek to come up with hybrid techniques which can be used in the formulation of a risk management framework to cater for the Project Development Stage of HPP/PPP.

Adequate analysis and allocation of risks amongst the contracting stakeholder's participation in PPP projects ensures financial sustainability and reduces project vulnerability (Sanda, Natalia, Anigbogu, Izam & Wuyokwe, 2019). Maria Jose Romero(2017), questions the sustainability of the PPP projects to tackle poverty reduction, fight against inequality, affordability for the poor, and environmental impacts. Why PPPs are not fully exploited in some community projects despite the cited superior competence, timely execution of infrastructure projects, and better aesthetic output? Hence, this literature survey section finds it imperative to first critically analyze the PPP concepts and link the analysis with the risk management process.

3.4.1 PPP Conceptual Variables

(i) Project Finance

The private sector has demonstrated to have the capacity to finance projects for the public that have been spontaneously affected by the financial upheaval (Hall,2015; Thiemann & Volberding, 2017). Thiemann & Volberding (2017) exemplifies that the government does not need to budget for infrastructure projects finalized on PPP models. Sikorova and Gallop(2015) cite Energy Eastern Europe Hydro Power GmbH and Austrian company, the Kelag group as among the prominent private firms in Europe financing an estimated total of 40 IDA countries Greenfield hydropower projects. In the case of Tanzania between the period 2003 -2013, over USD 3.7 billion was invested by the private sector into infrastructure development of which more than 80 per cent of the investment was channelled towards energy and telecommunication and 20 per cent went to the transport sector (Maria Jose Romero, 2017).

However, there is a profound need to judgmentally comprehend at what effort and interest rates do these private sectors manage to source for these finances? Further, at what cost does the public bears financial and transaction costs incurred by the financing partner? The private sector in this partnership has a principally commercial perspective (Declercq, 1999). The private sector’s interest (Declercq,1999), is to obtain an adequate return on investment (Mcquaid, 2010). Globally, various governments have resorted to PPPs as this initiative has been supported by the World Bank and embraced by the United Nations for the 17 Sustainable Development Goals (Hall, 2015; Boyer and Scheller 2018), which has declared that a massive increase in investment, including in public infrastructure is required to realize the social-economic and environmental goals.

Thus, it is not just a matter of finalizing a PPP agreement but how can the government yield aesthetics in infrastructure development, economic prowess, readily available goods and services for citizens, and an increase in national income (Wojewnik-Filipkowska & Węgrzyn, 2019). This is the gap which this research strives to fill in through identification, analysis, and mitigation of the risks that affect the attainment of sustainable development in PPP energy infrastructure projects.

(ii) **Technical & Managerial Expertise**

With regards to the technical and managerial expertise, the PPP's, classically features a large variety of interested and influential stakeholders, with diverse economic, technical, political, social, and environmental concerns (World Bank, 2014). Does the question rise on how effective do the public sector benefit from technical expertise? Are there skills transfer such that the public can technically operate the infrastructure when handed over to them or replicate the project on another site without the indulgence of the private sector? With these questions raised by this author, Wojewnik-Filipkowska & Węgrzyn (2019) states that a new approach to stakeholder engagement and technical expertise analysis in PPP projects must be enhanced to achieve more project success leading to sustainable infrastructure development. National Audit Office (2018), Schepper, et al., (2014) and Soomro et al., (2015) agrees that the financial crisis was not the only reason why capital value had dropped in PPP projects in the United Kingdom, the main reason cited was complex relationships in these projects. There was a huge gap between the PPP's stakeholders' expectations on the project outcomes to determine success (Schepper,2014). Thus, any mismatch in terms of expectations is a risk that affects project success.

In Nigeria, the research reviewed that any disputes between the interest and expectations of key stakeholders result in cost overruns and subsequent project failure (Afunanya, Achoru, and Williams,2016). The technical and managerial expertise which the private sector brings on board is critical as it enhances key stakeholder satisfaction. However, need arises to critically analyze the private sector's expertise to avoid situations where the public is misled due to the high technical data in the position of the private sector which is mostly referred to as information asymmetry(Parker et al.,2018; OECD,2014; Attarzadeh, 2014; Issa et al., 2012; Mendel and Goodman,2014; Oudot 2005; Devan n.d.). This information asymmetry is the risk that has the potential to be born whenever there is a huge technical gap.

(iii) Complex Project and Contractual Agreements

PPP projects are highly complex, wider magnitude and long term contractual agreements (Partnerships, 2018) such that due diligence, rigorous assessment, and project viability test must be exercised before procurement and financial closure is attained to avoid high risks (Private and Contracts, 2016; Demirkesen Çakır, Ozorhon, and Demirkesen n.d.; Syabari et al., 2014). Attarzadeh (2014) implies that due to the lengthy, costly and complex nature of projects, in the absence of effective negotiations to enhance risk allocation, it usually results in PPP failures (Kavishe, 2018; Zou, Wang, and Fang, 2008; ECI, 2003). Pakistan nation faced multiple blockades in the implementation of the project due to the complexity of PPP exacerbated by poor methodological comprehension, change confrontation and the impact of environmental factors (Khalfan and Maqsood,2012), legal and regulatory inefficiencies, project-specific risks and political instability (Fraser, 2005; Tillmann, Robert, and Shouqing, 2007). Mazher et al. (2017) infer that the contracting authority in Pakistan undertaking procurement tasks lacked a systematic risk management framework which is a prerequisite in complex project success in PPP.

The complex nature of PPP projects contributes highly to failure rates with examples including the Ports Master Plan project in Tanzania (Kavishe, 2018); contractual complexities breaches in China (A. Shrestha, 2015); Jakarta Water project in Indonesia (Romero, 2017); NRZ partnership project in Zimbabwe (Massimo, 2012) and Queen Mamohato Memorial Hospital in Lesotho (Romero,2017). It is this precedent that justifies the first research's specific objective to explore all the risks in these complex construction projects in particular hydropower projects finalized through PPP.

3.5 Complexities of HPP/PPP

The energy sector has a broad spectrum, however, this research picks up the sub-sector hydropower as it produces almost two-thirds of the renewable electricity generation in the world and it contributes highly in delivering on the ambition of the Paris Agreement including the Sustainable Development Goals(IHA, 2019). However, Yong (2010), accentuates that the complex nature of PPPs at the project development stage requires high-level political support to handle the obstacles that PPP projects designs meet which takes almost 3-4 years. Furthermore, Yong (2010) heightens that in addition to the hiring of the costly expert legal, financial and technical advisers for proper project design, internal capacity building must be facilitated among the public sector to manage transaction advisers effectively. In the same line, this author agrees that there is a risk of information asymmetry and lack of technical innovation that affects the public sector officials during the project operations which is true for hydro power projects marred with climatic dynamic changes.

Despite, the hydropower projects (renewable energy) favouring climate change campaigns (World Bank,2009), HPP/PPP projects are highly complex resulting in many risks which include resettlement schemes, flooding, and significant changes to river ecosystems (Sameer sadoon al-juboori,2003). If risks are not adequately identified and allocated appropriately, quantification of non-power benefits associated with a hydropower project such as economic improvements to livelihoods, improved local supply chains, enhanced navigation and transportation, and investment in community services becomes a challenge(IHA, 2019). From the earlier sections in this chapter, it can be deduced from the various authors that the complex nature of PPPs, project cost and time-consuming are the main contributors to the project failure if not adequately handled at the project development stage. A well-designed risk management model enhances (Zhang,2005) the achievement of the HPP/PPP project which balances mutual dependencies among different users within a sustainable guiding framework(Project, n.d; Mazher et al., 2017; Baloi and Price, 2003).

Bujagali PPP hydro Power Project in Uganda is a distinctive illustration of a PPP complex contractual arrangement. From the figure 3.2 presented, it can be inferred that from the complicated contractual dynamics and involvement of several key stakeholders of hydropower projects, there lies a lot of risks and uncertainties if non-robust feasibility analysis is undertaken and poor diligence during the selection of a private-sector sponsor (Yong, 2010). Bujagali hydropower project under PPP (Boudot, 2014; IHA, 2019; J Plummer Braeckman & Guthrie, 2016), was finalized by the BEL (private sector) and the Government of Uganda, including MEMD and UETCL, multilateral and bilateral development financial institutions, (Akintoye et al.,2003) and commercial lenders, including Absa Capital (South Africa) and Standard Chartered Bank (UK). BEL, which was a special-purpose vehicle (SPV), was incorporated in Uganda. This SPV is owned by Industrial Promotion Services (Kenya) Ltd (IPS (K), the industrial development arm of the Aga Khan Fund for Economic Development (AKFED) and SG Bujagali Holdings Ltd (Mauritius), an affiliate of US-based Site Global Power LLC (Boudot, 2014; Romero, 2017).

For such a complex model to yield positive results, it calls for effective project risk management techniques. Accordingly, PPP/HPP necessitates the suitable risk allocation associated with the complex financial, legal, organizational, political, and socio-economic structure, between the stakeholders.

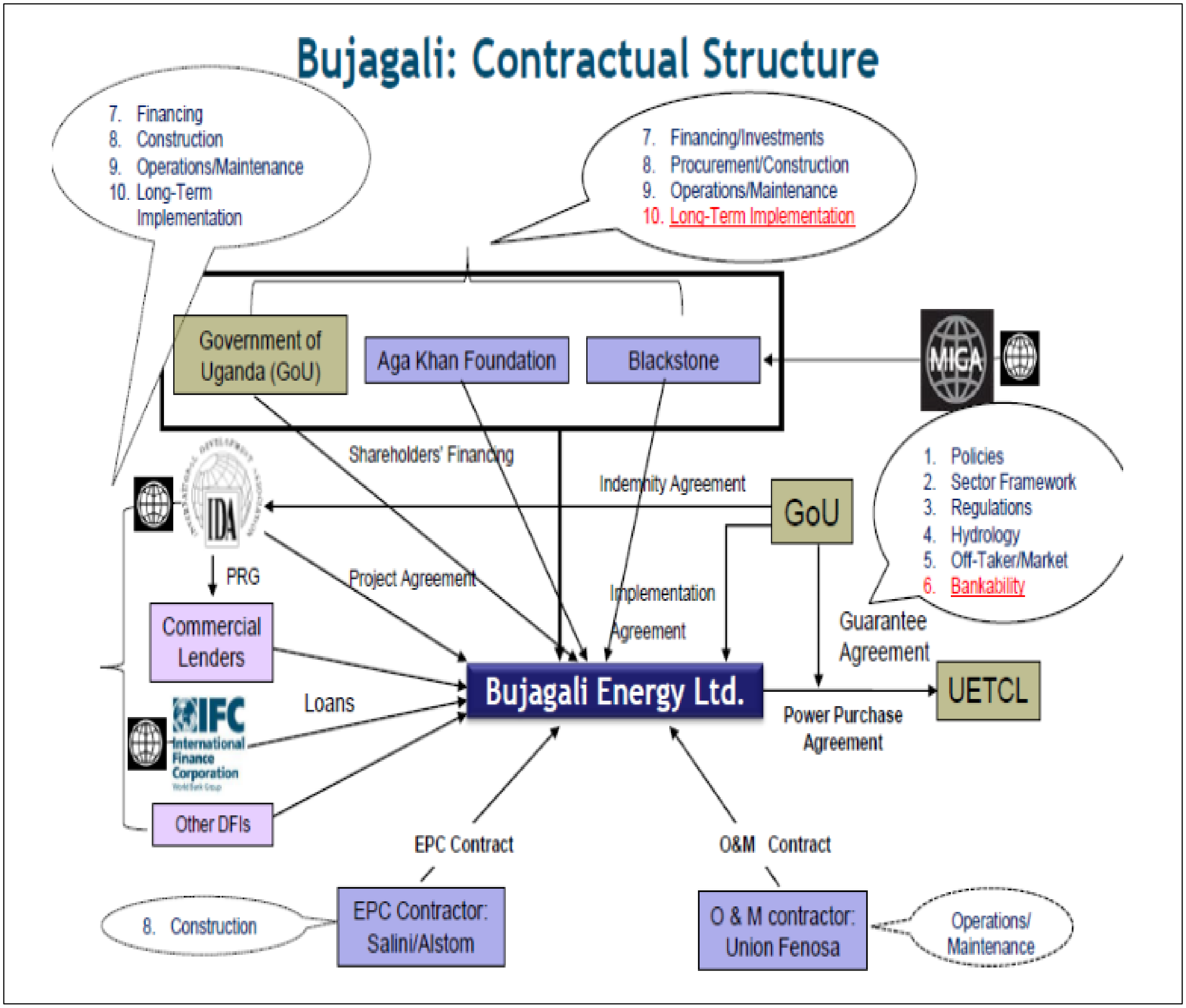

Figure 3. 3: Bujagali Contractual Structure -Source: Kabanda (2014)

3.6 Project Financing of HPP Infrastructure

Project finance is characterized by complex contracts that involve concessions, off-take agreements, and many syndicate contractual structures (Ameyaw & Chan, 2013; Lee, Han, Quising, & Villaruel, 2018a). Thus, inheritance risks associated with project finance must be managed well to enhance risk reduction, identifying opportunities, creation of an enabling business environment, and sureness for better judgment (El-nashar & Elyamany, 2017). The World Bank (2017) explains that shifting obligation to the private partner for project financing is what bifurcates PPPs and traditional procurement methods. The institution further explains that the private party has the responsibility of organizing debt and equity and developing the finance structure for the project. This process is known as Project Finance. Yescombe (2017), defines Project financing as a*..." method of raising long-term debt financing for major projects. It is a form of 'financial engineering', based on lending against the cash flow generated by the project, and depends on a detailed evaluation of a project's construction, operating and revenue risks, and their allocation between investors, lenders, and other parties through contractual and other arrangements"*.

There is no universally adopted definition of Project Finance, thus, this research adopts the definition by Gatti et al., (2012)…. *"the raising of finance on a limited recourse basis, to develop a large capital- intensive infrastructure project, where the borrower is a special purpose vehicle and repayment of the financing by the borrower will be dependent on the internally generated cash flows of the project"*

Hereafter, the public sector needs to fully comprehend the project financing process, the complexity of the projects, legal framework, and techniques for infrastructure development so that there is entirely cognizance of the potential challenges and implications for the government. This is the reason why a risk management model at the Project Development Stage on PPP projects is very critical for the key stakeholders (Desgrées du Lou, 2012). The financing structure of the PPP creates a Special Purpose Vehicle (SPV) designed by the private party with the detailed drive of delivering the contractual performance parameters (Alonso, 2015; Guide, 2016; Bing, Akintoye, Edwards, & Hardcastle, 2005; Hodge, Greve, & Boardman, 2010; Issa et al., 2012). It is a subsidiary company created for the implementation of a given project as it has its asset configuration and legal eminence to making it independent from the parent company (Ngoma, 2015; Europe, 2017; Issa et al., 2012). A combination of equity and debt is raised by the SPV from its shareholders by development banks or through bonds or other financial instruments respectively (Lukavec, Černá Silovská, Kolařík, & Jílek, 2018; Eberhard et al., 2016). Some of the known development banks include Exim Bank of India, Exim Bank of China, Development Bank Africa, and many more (The et al., 2019; Eberhard et al., 2016). The Private party shareholders are the first to suffer from any PPP project losses but lenders are only unpleasantly affected if the equity investment is lost (The World Bank, 2017). This entails that higher risks are accepted by the Equity Investors who demand a higher return on investment than debt facilitators. Equity is classically higher than debt in the range of mostly 70 to 95 % of the total project cost while debt ranges from about 25-30% (PPIAF, 2017; Lukavec et al., 2018).

Demirag et al.,(2012), states PPP projects possess a complex linkage of relationships involving multiple parties and their formal relationships. Furthermore, the assignation of extraneous investors and experienced leaders in an SPV attracts private investment, as it indicates a more relaxed society, where external investors and international financial institutions easily come on board(Wang et al., 2019). Thus, it can be deduced that optimal project finance can be achieved through the best combination of debt, equity, and including additional government support (Syabari et al., 2014). Hence, PPP government officials must fully understand the PPP models and Project Financing structure to enhance project success and mitigate the project finance risks. Figure 3.4 illustrates the various contractual arrangements found on a PPP project.

Project & Transaction advisors, experts, and professionals that are either unswervingly or circuitously involved in project financing also form part of the structure (Demirag et al., 2012; European Commission, 2014; Sobják, 2018). Furthermore, assets of the SPV or revenue streams generated is the only recourse for the lender in a project financing system (Gatti et al., 2012; Braeckman, 2008; Yong, 2010). The risk aspect of project finance is explained that even though the non-recourse or limited-recourse facet of project financing bounds the financing institutions to the SPV assets and revenues, there are several risks on this transaction that must be controlled during this process (England, 2018). Once the financing institutions are contented with risk management, then the loan is facilitated (England, 2018). Thus a risk management framework becomes eminent due to the degree of the investments which is way higher than the public sector capacity (Braeckman, 2008; Forum, 2015).

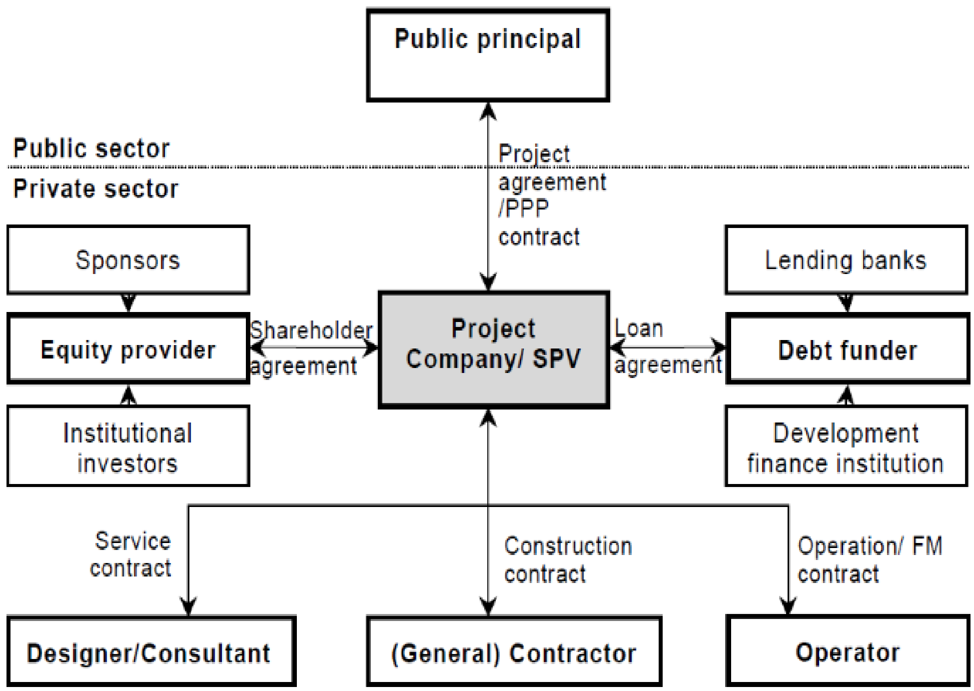

Figure 3. 4: Project Structure and Contractual Relationships in a PPP project – Source: Desgrées du Lou (2012).

Nevertheless, there are some future liabilities associated with Project Financing which must be taken care of during negotiations and be cognizant of it. McQuaid & Scherrer (2010), explain that the public sector must have a clear acknowledgement of the huge public investment using raised private capital as this has the probability of increased long term debts which are regrettable. Hence, a clear in-depth understanding of project finance serves as a risk mitigation measure and it must be explicitly incorporated in the risk management framework/model at the project development stage. Table 3.3 gives a brief overview of the project financing structure in a typical Private Public Partnership model based on some selected projects from a global perspective. The table illustrates the equity and debt distribution. This is a very critical component of project management such that poor handling of it results in project delay and subsequent failures.

Table 3. 3: Overview of the project financing structure in a typical Private Public Partnership model

Project	SPV	Equity	Debt	Remarks	Author
Amman's Queen Alia International Airport (QAIA) in Jordan.	Airport International Group	Abu Dhabi Investment Corporation (UAE): 40 %, Noor Financial Investment Company (Kuwait): 25 % − Joannou & Paraskevaides Overseas (UK and Cyprus) – J&P Avax subsidiary (Greece): 10% − Aéroport de Paris Management of France (France) 5 %.(Total estimated USD 305million equity)	European commercial banks, International Financing Corporation, and the Islamic Development Bank. (Total estimated USD 370 million debt)	Despite the significant technical and financial capacities of the project sponsors, the project suffered challenges due to legislative changes, high up-front capital costs, and non-allowable long payback periods that were required for a project of this size due to Political risk	(OECD, 2014; Farquharson, Torres de Mästle, & Yescombe, 2011)
The Ouarzazate Concentrated Solar Power (CSP) project, Morocco.	Moroccan Agency for Solar Energy (MASEN)	The Government of Morocco (USD 883 million-operational subsidies), ACWA Power International (95% Saudi Arabia), Aries Ingenieriay Sistemas (Spain), TSK (Spain) with an estimated USD 190 million of equity capital) 844183	World Bank-USD 200million, CTF (World Bank)-USD 197million, AfDB-EUR 200 million, EIB (EU)-EUR 250 million, AFD (France)-EUR 100million, KfW (Germany)-EUR 100 million and NIF (EU)-EUR 30 million	The project had a successful financial closure which was financed within budget despite its large capacity infrastructure and execution is done in a developing nation. The PPP model was cautiously designed with noteworthy financial and technical contributions, strong public support, and excellent stakeholder engagement and coordination of donors. However, poor institutional capacity, insufficient consistency, and collaboration between government agencies resulted in some minor	(OECD, 2014; OECD, 2019).

				operational costs. These risks if left unmitigated develops into uncontrolled costs. Insufficient data usually results in a risk called Information Asymmetry which has a drastic effect on the project objectives.	
Bujagali Hydropower Project, Uganda.	Bujagali Energy Ltd (BEL)	Industrial Promotion Services (IPS) – Kenya Ltd, the Industrial Development Arm of the Aga Khan Fund for Economic Development (AKFED) and SG Bujagali Holdings Ltd (Mauritius), an affiliate of US-based Site Global Power LLC.	($130 million loans from IFC, $115 million partial risk guarantee from International Development Association to commercial lenders, and $115 investment guarantee from Multilateral Investment Guarantee (MIGA)	The project had a well-developed contractual structure that guaranteed that the project-related risks, including completion and operation, were borne by the project sponsors and commercial lenders. This ascribed to the project's success. Also, the risks related to supply/input (hydrology risk), market, political, and natural forces were borne by the government of Uganda under the government guarantee and implementation agreements. The effective risk allocation exhibited on this project was attributed to success. This justifies the importance of risk management models as it increases project success	(Judith Plummer Braeckman & Guthrie, 2016; European Investment Bank, 2007; J Plummer Braeckman & Guthrie, 2016).

Itezhi-Tezhi Hydro Power & Transmission Line Project-Zambia.	Itezhi-Tezhi Power Company-ITPC	**Generation**: ADF loan: USD 17.8m EIB loan: USD 17.8m ZESCO shareholding in ITPC: USD 0.26m Tata shareholding in ITPC 35.86m **Transmission**: ADF loan: USD 25.93m NTF loan: USD 10.00m EIB loan: USD 34.00m AFD funds: USD 34.00m GRZ/ZESCO: USD 7.24m	**Subordinated loan** - India Exim/ZESCO: USD 29.04m **Senior Loan** ADB USD 34.57m DBSA USD 34.57m FMO, USD 34.57m PROPARCO USD 34.57m	The risk of shareholder's incompetence was mitigated due to the time-honoured experience in managing hydropower generation and transmission assets by ZESCO while Tata Africa Holdings Ltd. and its mother company have a significant track record in the independent power sector which made this PPP successful. Also, the contractor selected, Sino Hydro is an international firm in hydropower development and has noteworthy experience in handling multiple projects across diverse continents. However, the failure by the community of Itezhi-Tezhi to identify projects to be implemented under the corporate social responsibility by ITPC has poorly affected the community in terms of benefiting from the project. Hence, the sustainability principle advocates for people's welfare, environment, and economic benefits.	(Godet & Pfister, 2007; African Development Bank, 2011; Project, n.d.; Mweemba, 2015).

Compiled by Author (2019)

3.4.1 Barriers Accessing Debt capital markets in Energy Infrastructure Projects.

The benefits of energy infrastructure are so understandable but the question which must be raised is why are there few infrastructure generation projects successfully implemented? Ehlers (2014) explains that the finances are readily available on the world capital markets for any infrastructure development projects with very low long-term interest rates. The issue is for the promoters to present an investable project and preparation of acceptable bankable documents. A well-presented business case with a supporting risk management framework/model is what the Pension funds, insurance companies, and other long-term institutional investors look for before committing their resources (Ehlers, 2014).

Vardaro et al. (2016), states that the power challenges facing the SADC region today can partly be attributed to the non-cost reflective tariffs as the opposite (Cost reflective tariffs) aids investors non-cost reflective tariffs do not encourage refurbishment and upgrade in infrastructure and other equipment leading to power outages and low voltages (Vardaro et al., 2016). Also, in Zambia and many developing nations, the scope of investments in the energy sector is, however, limited by regulations in terms of operations and pricing (Phiri. 2017), and political influence(Roach, 2016; Sameer sadoon al-juboori, 2003). These are some of the factors that may impede capital injection in the energy sector, hence, the potential investors rely on the risk analysis framework and risk register to go ahead with the investment (Suđić et al., 2017). The other significant challenge is in the credit rating requirement (Dean, 2014; Thiemann, M., & Volberding, 2017), as most international financing institutions and investors can only invest in assets with a credit rating of AA or above A+ with special approval (Nguyen et al., 2017).

For instance, in Zambia, the IMF (2019), Debt Sustainability Analysis report stated that the public sector obligation was high with the public stock debt reaching 78 per cent of GDP at end of 2018 from 65.5 per cent in 2017. External debt augmented from $9.5 billion (38 per cent of GDP) in 2017 to $11.3 billion (48 per cent of GDP) in 2019. It can be reasoned that the stock of public debt skewed more towards external debt, this exposed the debt portfolio to external vulnerabilities and fluctuations in foreign exchange rates (Banda-muleya & Nalishebo, 2018). Consequently, this type of debt portfolio detects private investors to undertake huge infrastructure projects due to the significant level of risks associated with partnering with a public sector that has an unfavourable credit rating. It is even more difficult for an SPV- a special-purpose vehicle to get a credit rating of AA or higher at the pre-commissioning stage. CEPA (2015) augments that barriers to local financing of infrastructure are not only related to the nature of the projects available for investment that fails to meet the financing requirements of investors (see figure 3.4), but also lack of available capital related to financial market conditions (Rajé,2017).

Hence, it was this complexity of credit assessment and higher interest rates that made the private sector reorganize the financing strategy through exploring shareholders equity, bonds, syndicated term loan, and Development Banks. Though, this comes with a lot of economic risks and financial risk factors justifying the need for effective risk management systems at the project development stage (Roach, 2016; Sastoque et al.,2016; AfDB, 2013; J. Li & Zou, 2014; Mudi, 2016). Figure 3.5 illustrates the upstream constraints, depicts the lack of an enabling environment, appropriate legislation and capable institutions that have been proving to be a barrier to private investment. Failure to pay for infrastructure services by the public and different interest groups works against PPPs. The downstream constraints state that limited interpretation of bankability of the project, financial skills by stakeholders is so significant (Rajé, 2017).

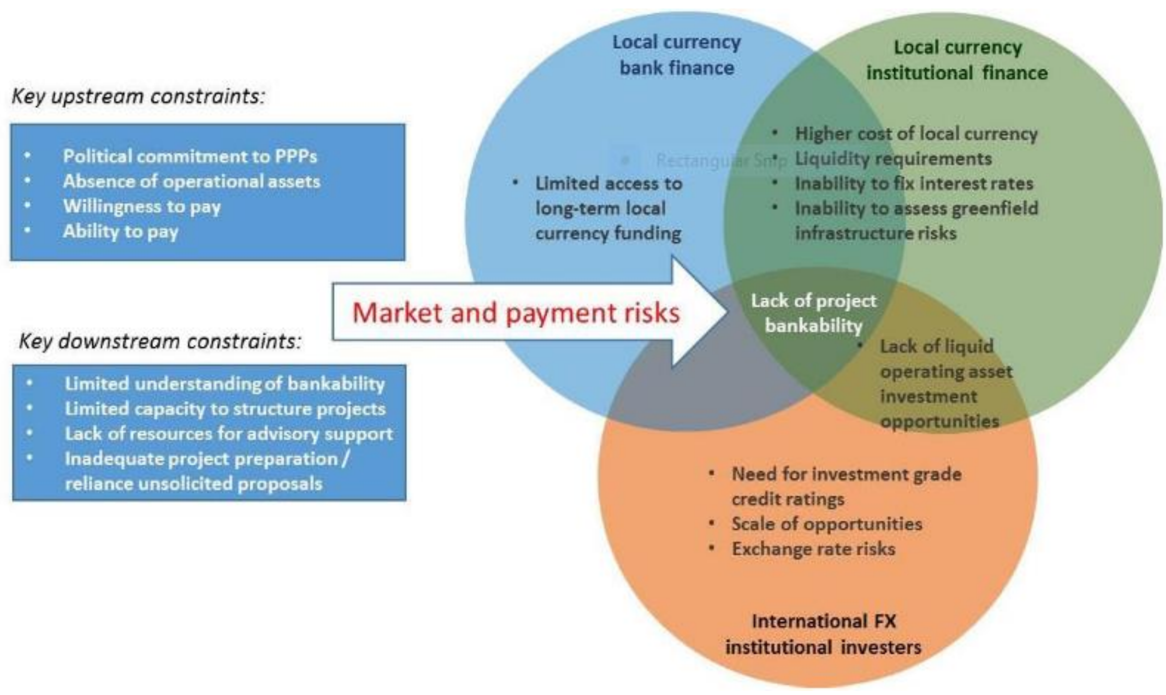

Figure 3. 5: Barriers to private financing of infrastructure focus countries Source: Adopted from (Rajé, 2017)

This research strives to find the solution for the interventions that have been and can be used to resolve barriers to financing energy infrastructure in Zambia and relevant mitigation measures for the risk factors (Technical, Legal, and Financial) mentioned in the Public-Private Partnership Act, 2009 (Zambia-Development-Agency, 2014).

CEPA (2015) recommends a high-level grade of continuing political commitment that should be above government changes. The commitment inters developing an equal level of focus with technical matters such as developing a legal and regulatory framework, project preparation, and modes of financing. Rajé(2017) cites South Africa, India, and Kenya as countries that have enhanced private financing by developing through capacity building in preparation, negotiating, and transacting of PPP projects. The author continues that the relevant line ministries must develop the needed experience of identifying potential PPP opportunities and undertaking initial analysis for the enhancement of the bankability of the projects (Rajé, 2017). The critical success factors to increase private finance to energy infrastructure in a developing nation such as Zambia includes;

a.) Tariff reforms in services such as cost-reflective tariffs (Phiri & Ziba, 2018).
b.) Energy Sector reforms (IHA, 2019;Sikorova & Gallop, 2015; Ngoma, Mundia, & Kaliba, 2014;Maria Jose Romero, 2017).
c.) Early-stage project development support (Rajé,2017)
d.) The enhanced risk management process in energy infrastructure development(Judith Plummer Braeckman & Guthrie, 2016; Aggarwal et al., 2016).
e.) Political commitment(Rajé,2017; Wilhelm, 2009;Fombad, 2013).

This author deduces that private sector engagement in energy infrastructure is fundamental to the Zambian governments and any other developing nations in line with the struggle to attain some sustainable development goals. However, policymakers need to custom regulatory frameworks that facilitate sustainability for private investment and the attraction of foreign direct investments (FDI) in energy infrastructure. Furthermore, through the Zambia Development Agency, there is a need to have some clarity on the procedures and strategies for investors. Also, ensuring that the contracting authority is better prepared for engaging in specific energy generation projects. Finally, a good design risk management framework that allocates the risks among the stakeholders holds the key to PPP success.

3.5 Value for Money as Basis of Public-Private Partnership (PPP)

Effective utilization and application of innovative techniques by the stakeholders enable the attainment of the agreed objectives (Chowdhury, Sharma, & Platz, 2016; Lee et al., 2018a). Furthermore, the complexity of PPP contractual agreements and the participation of numerous stakeholders are among the risks that cause the cancellation of projects hindering the achievement of Value for Money (Lee et al., 2018a). The justification for the increase in the preference of PPP model used is the concepts of value for money attainment on projects (Sastoque, Arboleda, & Ponz, 2016; Saiyed, 2015), this is what motivates governments around the world including the United Nations System (Bartsiotas, 2014; Kurniawan et al., 2015). The research, endeavours to illustrate the features of Value for Money on PPP projects. Several researchers have cited political risk as among the many risks that hinder the attainment of VfM on projects(Miranda Sarmento, 2014; Sastoque et al., 2016; Reside, 2008). Therefore, VfM is exemplified as the optimum combination of the whole life cost of the project, the aesthetic of the product or service to meet the user's requirement and the integration of financial and non-financial aspects in the appraisal (Takim et al., 2011).

Takim et al., (2011) argue that the VfM assessment must be steered during the project development stage together with the economic viability analysis of the project to determine output specifications. Furthermore, during the procurement stage, the process of assessment continues where there is a comparison of the offers (net present costs of PPPs) being made and the Public Sector Comparator model to ascertain the VfM. Thus, it can be inferred that VfM does not only look at the financial aspect but also the superiority of services, amenities management, environmental facets, public interest, and any other contractual matters within the battery limits(Andrade & Loiola, 2013). This investigation strives to emphasize the prominence of having a risk management framework at the project development stage (feasibility, planning, and procurement) so that VfM achievement is enhanced. This aligns with the vitality of the development stage as once risks are identified and mitigated earlier, there is an increase in project success.

However, there is a need to decisively analyze VfM in the broadest possible sense. At a basic level, the total cost of a well-executed aesthetic PPP Model must be justified with VfM(Chowdhury et al., 2016). Correspondingly, the comparison must be done on the performance outcome if the work was to be executed by the public sector. Chowdhury et al., (2016), further explains that the most appropriate way of achieving value for money is to take into consideration the transaction costs related to tendering and negotiations, whole cycle financing system for the project, operational and maintenance costs up to the handover of the project to the government. This statement has been justified by the fact that private capital investment possesses inherent risks which entail the utmost integration of the best practice of fundamental commercial techniques to achieve VfM (Gerrard, 2001; Olele, 2016; Leong, n.d.). Therefore, this gives validation of having a well-designed risk management system in place at the project development stage as it incorporates all the risks which may arise at the project execution and operational stage(Grimsey and Lewis, 2004; Minnie, Prof, & Burger, 2011). Among the predominant risks are contingency liabilities and deceptive techniques of assessing value for money (Chowdhury et al., 2016).

In an event where there is poor risk allocation, risks end up with the party which is not able to handle them resulting in project failures (Cameron Xhala et al., 2017). A proper risk management technique must be designed or adapted so that the allocation of project risks is done to the partner with the capacity to manage the risks with the required cost-effectiveness. Value for Money (VfM) is never achieved where development, construction, operation, and maintenance risks are allocated to the party with the inability and capacity to handle them. Hence, developed countries that have long experience in PPP implementation have well developed and articulate risk management techniques that enable them to release optimum benefits from these PPP modelled projects. Public Sector Comparator (PSC) has been developed as part of well-documented methodologies to assess VfM. PSC is when the government estimates the risk-adjusted costs and benefits of a project, comparing two alternative hypothetical scenarios: one assuming a private-sector delivery, and a second assuming a public sector delivery (Aldrete et al., 2010).

In addition to the scholars above, Li et al. (2005) recommend that for the Public sector to achieve VfM, it must adopt a well recommended international standard procurement procedure that is tight free from manipulation. Furthermore, there is supposed to be proper market research and project identification needs and conducting due diligence on the private sector. Despite the recommended procedure being tedious and costly for both parties compared to the traditional method, this has the utmost benefits to avoid project failure. Hence, the various government have developed a model to build on the principle of proper allocation of risks and legal framework in the drafting of the concessions (B. Li, 2009). However, the Zambian PPP legal and regulatory framework, dedicated risk management has not yet been developed including the regulations and statutory instruments to support the PPP legislature.

This author construes that the risk management process in PPPs must integrate the VfM assessment so that all underlying issues of efficiency gains, contract management system and schedule of responsibilities among the parties, social-economic benefits and environmental objectives as expressed in the 2030 Sustainable Development Goals (9) are attained (Bartsiotas, 2014; Zou et al., 2008; Li and Akintoye, 2003; Johnston, 2016; United Nations Economic Commission for Europe, 2017; R. McQuaid, 2019). The joint action brought on board by the stakeholders on PPP models has proved to achieve the project objectives and enhancement of the attainment of VfM (José Oliveira dos Reis & Cabral, 2017). Chowdhury et al. (2016), concludes that well-structured institutional capacity plays a pivotal role in the PPP assessment.

3.5.1 Examples of VFM on Mega Construction Projects

World Bank (2017), reports that VfM has been highly achieved in PPP projects in Chile and Mexico. Furthermore, some more extensive track records on PPP projects have been in Brazil, Colombia, and Peru (World Bank, 2017). However, some non-attainment of VfM projects includes the Light Rail Transit (LRT) Kuala Lumpur project for the reduction of city congestion in Malaysia(Rahman et al., 2014). The failure of the LRT project was attributed to poor quality and project delays which led to the nonfulfillment of stakeholder's requirements (Abdul Rahman et al., 2014). Thus, VfM is not guaranteed if risks overburden the project, this gives further justification for the need to have a well-designed risk management system at the project development stage so that risks are proactively identified, analyzed and mitigated to enhance the project success. Another example includes the BERTS in Thailand, M9 Motorway in Pakistan, and Belgrade Novisad Motorway in the Czech Republic (Soomro & Zhang, 2013) which was attributed to poor appraisal of the private partner.

And in the energy sector, some recorded failed PPP projects among many more include Tata Mundra Ultra Mega Power Project in Gujarat, India (Eurodad, 2018), which faced serious social and environmental risks due to poor planning and project due diligence. This resulted in deterioration of water quality, dwindling fish populations, community health issues, and disturbance of the community establishments. Eurodad (2018), further states that poor planning resulted in the forced displacement of fishermen that subsequently affected the lives of women. Another project is the Castor Project in Spain which was to be the biggest offshore gas storage plant. However, the project execution encountered more than 1,000 earthquakes in the geographical area which was not prone to seismic activity in the past. This resulted in the public cost of €3.28 billion, which is presently being paid through increased gas bills (Eurodad,2018). If efficient risk modelling was incorporated at the project planning stage, the losses could have been reduced or avoided.

This author assumes that the failure of the above-stated project was aggravated by the poor integration of VfM and risk management in the PPP model. The achievement of VfM on a mega construction project requires a well-detailed risk management system, efficiency in the execution of the project to meet the completion date, reduction in project cost escalation, innovative techniques in project development, and ensure that the detailed specification meets or exceed stakeholder's expectations.

3.5.2 Gap Analysis and Operationalization of the VfM on HPP/PPP in a Zambian Context

Management of risk is one of the critical mechanisms of project management, poor controlling of the same or mitigation, there prove to be the primary causes of project failure and including non-attainment of the Value for Money (Lyons & Skitmore, 2004). Hence, the execution of the projects must be done in a novel way such that there is a need to plan and execute them in light of their connection to the strategy. The strategy inters linking the projects with the objectives if VfM is to be achieved. Thus, the project must be the actionable arm of the risk strategy if the VfM is to be attained (Bain, 2009; Demirkesen Çakır et al., n.d.). This is what is missing in most literature which this author looked at in terms of attainment of VfM on projects. There is much on the process, but the strategic concept of linking the project to the objectives is not salient. Another observation is that VfM must be based on the whole life costs of the project or service (Personal et al., 2016), not on the lowest bid.

Moreover, in the operationalization of the concept, economy, efficiency, and effectiveness are some of the well-elaborated elements that must be highly considered in VfM (Personal et al., 2016). Batho Pele (2007) elucidates the elements as follows; Economy – explores whether precise contributions are attained at the lowermost price and at the veracious time. While efficiency- refers to how efficiently contributions are translated into productivities with a diminutive cost. And Effectiveness- infers to which productivities accomplish the anticipated outcomes. In consideration and adequately incorporating these three terms in the finalization of the project, it enhances the total cost understanding of the project life cycle and its sustainability (SCI-Network, 2011). Figure 3.6 gives a brief illustration of the flow of 3Es explained in the paragraph.

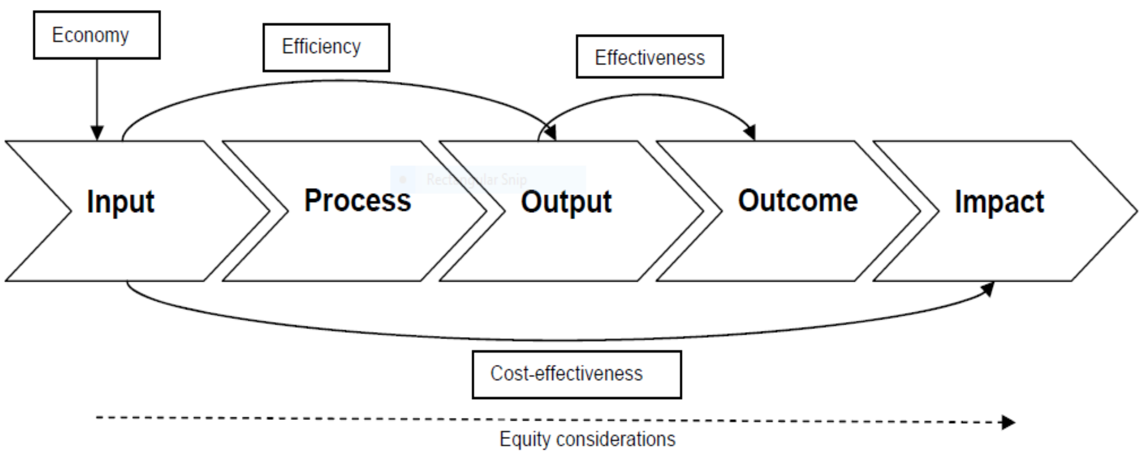

Figure 3. 6: DFID’s 3Es Framework Source: Department for International Development (2011),

The above illustration of equity considerations to attain value for money is what is missing in the HPP/PPP in Zambia. There is more emphasis on output than the process as evidenced by the surveyed literature.

For the attainment of Value for Money, infrastructure development cannot, and must not, take place at the expense of the environment and livelihoods. The sustainability aspect must be incorporated into the structure, design, implementation, and operation of HPP infrastructure to enhance the reduction of the adverse environmental and social footprint. This is evidenced in India where well-built infrastructure in road and power sectors becoming a menace to the public due to corruption(Hall, 2015; Shaibu, 2018). Thus for the Zambian government to achieve the VfM from the energy infrastructure, there is an emphasis on the promotion of renewable energy (Ali, Anwar, & Nasreen, 2017; Bozkurt & Akif Destek, 2015) as it is of supreme prominence and an essential prerequisite for national development goals achievement (Low & Countries, n.d.). Therefore, it should not be related to the cheapest option, but there is a need to get to understand the cost driving attributes and ensure there are the quality desired outcome and time-bound aspects. And this must be worked out with all the stakeholders in the PPP contractual arrangements.

3.6 Sustainability of PPP Energy Infrastructure Projects

There are several public-private partnership (PPP) development projects being undertaken at a global level (Kakati & Dean, 2016), despite the complexities associated with these developments(Liang & Wang, 2019). Therefore, there is a need to ensure the design, planning, and finalization of the PPP agreements are linked to performance measurements to achieve stakeholders' interests in line with economic, environmental, and social sustainability(Liang & Wang, 2019). This author presupposes that if there is no yardstick to guard the PPP agreements and the private sector, there is a high probability of undertaking these projects without putting into consideration the environment, social-economic impact on the community, and ethical aspect.

Sustainability risk is prone to huge projects such as hydropower (International Hydropower Association, 2018; Judith et al., 2016). Since, there is a multidimensional nature of sustainability (Tang et al., 2018), this research aligns this risk to the environment, economy, and society. Sustainability is an imperative inclination to be incorporated in PPP projects without fail (Du et al., 2018). Additionally, the project activities must not negatively influence the economy, society, and environment (Du et al., 2018). The Canadian Institute of Chartered Accountants (1990), explained sustainability as follows; with regards to the environmental dimension, it relates to defending and establishing the production measurements of environmental systems. Then, with regards to the economic dimension, it refers to the exploiting present benefits of economic development including the future without tampering with preferred artistic (Hwang, Shan & Lye,2018). And lastly, in social terms, it inters the utmost quality of life improvement and continuity in accessing necessary resources without interference in human rights after the project. Risk has been adequately defined in chapter one (refer to section 1.4). A lot of benefits of PPP have been mentioned in a chapter in the previous and this chapter, but there is a need to understand the remedies of PPP project failures that pose a menace to the sustainability of projects . Thus, this research strives to explore risk factors that affects attainment of sustainability of the PPP/HPP in a developing nation like Zambia.

Performance measurements if not properly designed hinders the sustainability of the PPP projects (Liang & Wang, 2019). Liang and Wang explain that performance parameters once agreed upon on the PPP agreement holds the key for efficacious performance of PPP projects. As much as there is an appreciation of that Cost, Quality and Time enables to provide the check and balance on the project, Zheng et al., (2018), states that there are some high risks of project failures or suboptimal outcomes. Thus, to mitigate this risk, stakeholder management needs to be highly incorporated in the establishment of performance measurements for PPP projects(Sy et al., 2016). Sy et al. (2016), further explains that the measurement of the project performance must be done from the perspectives of key stakeholders associated with the project. To hedge the risk of project sustainability failure, this should be done at the earlier stages of the project so that the criteria of sustainability are among other requirements for the best bidder.

The PPP projects possess traits of complexities and longevity that provide the platform for various risks that affect project sustainability (Grimsey and Lewis, 2002; Du et al., 2018). Kumar, Fouzdar, & Duggal, (2016), identified nine risks that predominately affects the sustainability of the PPP infrastructure developments shown in Table 3.4:

In China, the construction companies are highly regulated by the central government and local governments in terms of fulfilling the corporate responsibilities so that the public sector can in return engage them on investment opportunities, accessibility of finances, and general stimulus package backup by the government (Liang & Wang, 2019). Eberhard et al. (2016) enlighten that China is ready to finance the energy generating projects in 19 countries so far in Sub –Sahara Africa. Moreover, China Exim Bank has been at the forefront of financing these projects in collaboration with the government of China and some other banks (Eberhard et al., 2016). Zambia has several major construction projects including the development of energy generation projects being executed by China. (Banda-muleya & Nalishebo, 2018). Fioramonti et al. (2011) argue that countries in Africa get into this business relationship in good faith expecting mutual economic growth, environmental sustainability, and qualitative energy infrastructure development (Yu, 2014).

Table 3. 4: Risks Affecting Sustainability of PPP Project

Risk Factor	Source
Technical risk – Poor engineering and design failures.	(Farquharson et al., 2011; Issa et al., 2012; Delmon, 2012; Anandh & Vinoth, 2018);
Construction risks- pitiable construction techniques and innovation, lack of cost estimation systems in fluctuating economics and poor project management integration	(Osei-Kyei & Chan, 2017a;Baloi, 2012;De Marco & Jamaluddin Thaheem, 2014;Kashiwagi & Kashiwagi, 2012;Zimmermann & Eber, 2014)
Revenue risk –Public resentment and protest of the produce/service, failure to attract demand, poor marketing techniques.	(Hall, 2015b;Bruchez, 2014;Associates, 2017;Mccann & Busadm, 2014;Bridge, 2016)
Financial risks - inadequate hedging of revenue streams, corruption, loss of confidence, global recession, and financing costs.	(Document, 2018;Hall, 2015b;Barnett, 2017;Ke et al., 2011;Fombad, 2013)
Force majeure risk- war, diseases (COVID-19, Ebola), and other calamities.	(Document, 2018; Neupane, 2018; Dunn, 2017; Ke et al., 2011; Anh Nguyen et al., 2017)
Regulatory/ political risk- legal changes, government changes, opposition, and unsupportive government policies.	(Al-Saadi & Abdou, 2016;L. M. Tshombe & Molokwane, 2016;Coleman & Gfroerer, 2012;Zou et al., 2008;Osei-Kyei et al., 2017;Fischhoff et al., 1984)
Project default- Poor project governance, failure of the project from a combination of various risks.	(Olele, 2016;Jagdale, 2016;Hovy, 2015;E. Bank, 2012;Bekker & Steyn, 2009)

Compiled by Author (2019)

Nevertheless, is the win-win situation between China and Africa critically analyzed by the key stakeholders involved in finalizing these agreements? Is the sustainability aspect incorporated in these energy infrastructure projects? This void is filled by this research by exploring the sustainability of PPP energy infrastructure projects in developing nations through identifying the risks which can hinder the PPP projects from not being sustainable. The information is very critical to government officials, project financers, project developers, international and local communities on the importance of sustainable development in line with the PPP and the 2030 Sustainable Development Goals (Chowdhury et al., 2016). This whole quintessence endeavours to minimize project failures and enhance project performance including the highly needed sustainability. As much as it is well acknowledged that hydropower projects present more benefits, there are several negative effects on the environment such as interruption of water supply, change of activities for the community and resettlement issues (Tang et al., 2018). Hence, the sustainability of hydropower projects is threatened if not managed well. Figure 3.7 and Table 3.5 presents some sustainability explanations and hydropower projects finalized by the Chinese government between 2001-2004 in the sub-Sahara region. The data presented include the name of the project, country, project costs and capacity in megawatts.

Table 3.5: Largest Chinese Funded Project 2001-2014 in Sub Sahara

Project	Country	Investment (USD, millions)	Capacity (MW)
Karuma Hydropower Project	Uganda	1688	600
Zungeru Hydropower Project	Nigeria	1293	700
Morupule B Power Station	Bostwana	970	600
Omotosho Power Plant II(NIPP)	Nigeria	660	513
Memve'ele Hydro power Project	Cameroon	637	201
Bui Hydropower Project	Ghana	621	400
Soubre' Hydropower Project	Cote d Ivoire	571	270

Source: (Eberhard et al., 2016)

3.6.1 The sustainability appraisal of hydropower Projects

Li & Zou (2014) explains that several quantitative methods are presently used in risk assessment. These include ranking such as the use of scales (1 to 5) to measure its probability of occurrence and its consequences-impact((Tembo et al.,2015; Akrm & Alwahab, 2015; Aldrete et al., 2010; Hamududu & Killingtveit, 2012:Sy et al., 2016). Others include; sensitivity analysis (Bain, 2009; Taliotis et al.,2014), Monte Carlo simulation(Dunn, 2017; Jagdale, 2016; Fombad, 2013) fuzzy set(Ernest et al.,2016; Yehoue et al., 2014), analytic hierarchy process –AHP (Kaliyamurthi, 2017; Atanasova-pacemska, Lapevski, & Timovski, 2014). Execution of PPP projects with the sustainability approach, it upshots increased the quality of life and ensuring the harmony of environment, economy, and society with the aid in minimizing risks for future generations(Bozkurt & Akif Destek, 2015). Sustainability measure and enhancement of value for money (VfM) in PPPs is cardinal(Yong, 2010), due to the following reasons;

a.) Vigorous feasibility investigation is indispensable for PPP success, without this stage carried out well, there have been some recorded failures due to being over-optimistic about future revenues(Reddy & Sharma, 2017; Mazher et al., 2017).

b.) The selection of the private sector must be finalized after well-executed due diligence. (Demirag et al., 2012).

c.) Even with the availability of private finance, the PPP model only gives optimal results once sustainability and value for money are precisely integrated (Yong, 2010).

The construction of hydropower dams is highly associated with environmental and ecological impacts, which affects several people's livelihoods downstream (Okuku et al., 2016). The situation defies the definition of sustainability. These impacts range from the dislocation of people, weakened living values, lack of food supplies, and many social & cultural amenities enjoyed before the projects (Chandy et al., 2012; Jamal et al.,2014). The key issue is at what point should these aspects be put into consideration on the project life cycle? This is the reason this research strived to prove the hypothesis theory that having a well-designed risk management framework/ model at the project development stage (feasibility, planning, and procurement) minimizes the impacts of the risk on the stakeholders and enhances value for money including sustainability of projects. This author's assertion emphasizing the importance of the risk management system at the project development stage is in line with researchers (Okuku et al., 2016), who stated that environmental, natural, and social effects of dams are habitually unforeseen and undervalued at the development stage of the hydro projects.

A typical example is the hydropower generation project on the River Tana in Kenya on which project construction works went on without carrying out effective feasibility studies (Odingo, 1979). There were more negative effects than the projected positive aspects of these hydropower projects (Okuku et al., 2016). The author concluded that there was poor stakeholder consultation during the project development stage. This rationalizes a more sustainable approach and incorporation in the project development stage so that a detailed basin-wide socio-economic assessment is done. Thus, the promotion of the use of various sustainable frameworks and models in hydropower projects. Similarly, scholars advise that the culture of accountability, transparency and inclusiveness needs to be implemented in future hydropower projects plans including all stakeholder's perceptions to be considered in the process. (Fombad, 2013; Galilea & Medda, 2010; Thiemann, M., & Volberding, 2017;Yankson et al., 2018).

Kirchherr & Charles (2016), explains that the Sustainable Livelihoods Framework (SLF) implies that an effective combination of human capital (skills, acquaintance, and well-being), social capital (linkage and stakeholders engagement), natural capital (natural resources stocks), physical capital (infrastructure) and commercial capital (monetarist resources) leads to improved livelihood. Improved livelihood outcomes which are attained through well-executed HPP/PPP projects according to the Sustainable Livelihoods Framework (Kirchherr & Charles,2016) include;

- (i) more income (Yankson et al., 2018)
- (ii) increased well-being (The World Bank, 2013; Du et al., 2018; Sarmento, 2014).
- (iii) reduced vulnerability (Hankins, 2009; IUCN et al., 2004)
- (iv) improved food security (Low & Countries, n.d.)
- (v) sustainable use of the natural resource base (Chowdhury et al., 2016).

Figure 3.7 illustrates the Sustainable Livelihoods Framework (SLF). This framework encompasses the skills, assets, and approaches that are a requirement for individuals and communities to survive.

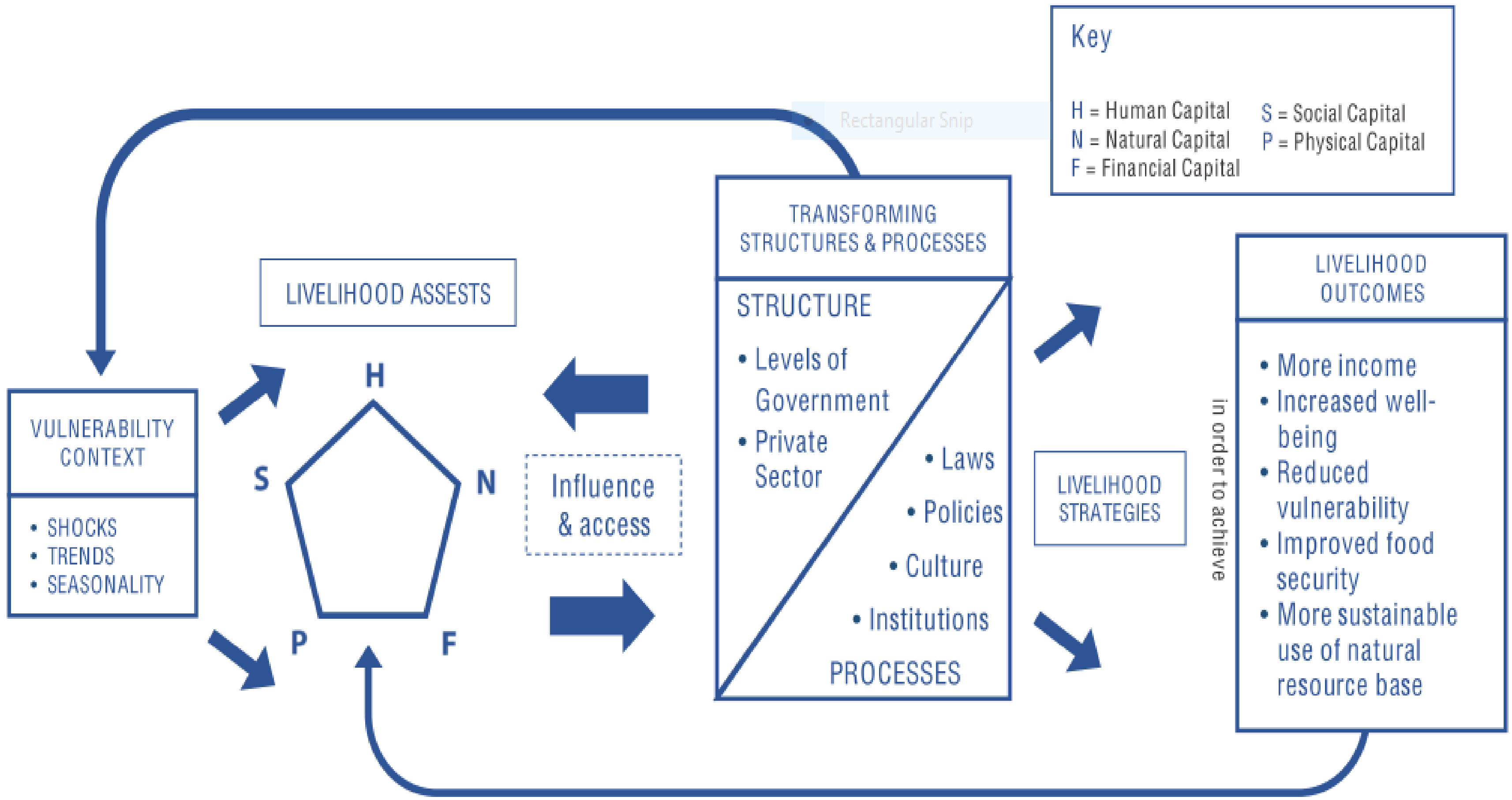

Figure 3. 7: Sustainable Livelihoods Framework-Source: DFID (1999)

Figure 3.8 shows the measurement performance of PPP to enhance the achievement of project sustainability and objectives. It gives a typical key performance indicator that must be agreed upon by the public and private partners at various project life cycles. The figure promotes the importance of firmly ensuring the definition of the output specifications is outlined and the process of achieving the same is in adherence to the PPP project fundamentals (Commission,2017; Ponis & Ntalla, 2016). Performance measurements must be negotiated, agreed upon, and enshrined in the contractual agreement by the partners (Walker & Pryke, 2008).

Sustainable Performance Measurement System for PPP.

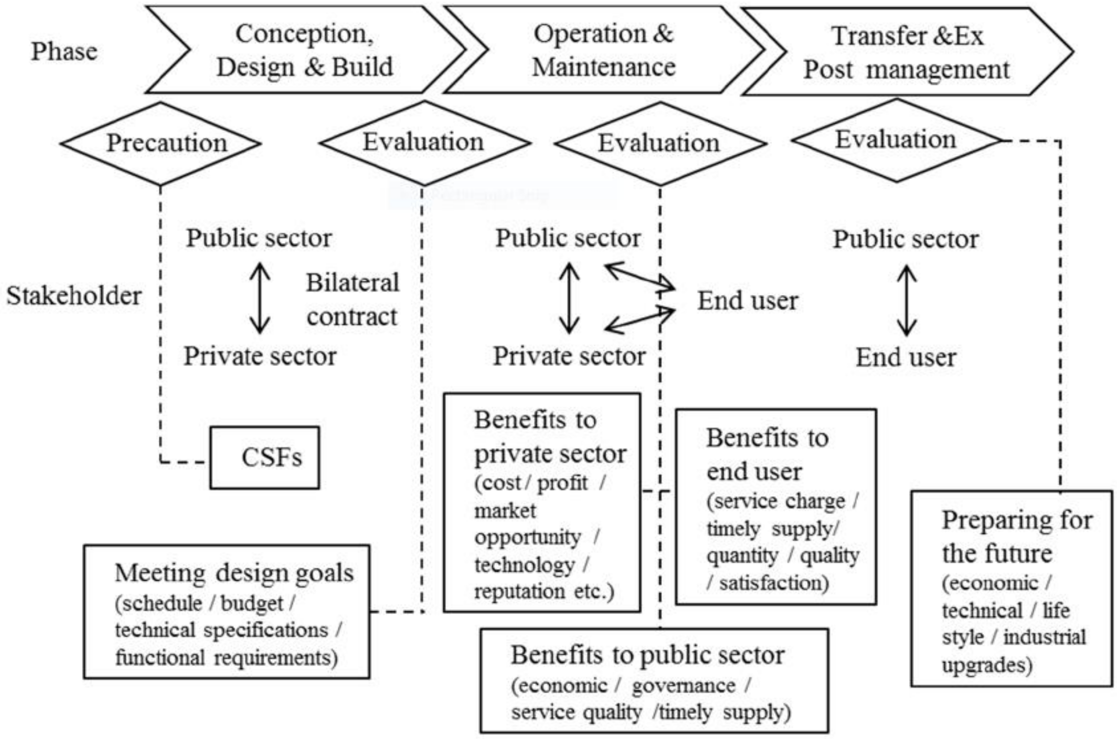

Figure 3. 8: Sustainable Performance Measurement System for PPP. Source -(Liang & Wang, 2019)

3.7 Summary

This section briefly looked at the overview of PPP concepts, operationalization of the same, the importance of Value for Money (VfM) on PPP infrastructure projects, and the sustainability of projects. The gap established is the lack of integrating risk management frameworks in most PPP models. Also, the issue of non-collaboration between government agencies has been an attribute to the confusion surrounding PPP concepts. And finally, the issue of Corporate Social Responsibility must not be treated as favour it should be part of the package so that the hoisting community buys into the project. This has attributed to communities not supporting some of the hydropower projects affecting the sustainability aspect.

3.8 Knowledge Gap Analysis

Table 3.6 presents some knowledge gap analysis on some salient literature covered by this chapter.

Table 3. 6: Knowledge Gap Analysis

Topic	Findings	Methodology	Gap Analysis	Author/s and Year of Publication
"Public Sector Infrastructure Delivery through Public-Private Partnerships in Zambia"	*Obstacles to project success:* overruns in schedules, escalation of costs, shortfalls in quality construction projects Identified risk factors had more than a 75% chance of inhibiting project delivery. *Prevalent Risks in Implementing PPPs:* Stakeholder project approval, corruption, inflation, inappropriate legislation, and inexperience in PPP arrangement.	The paper elaborated well on the research methodology for the study. Structured interviews and content analysis of the literature review was conducted. questionnaire surveys	The paper was well presented and content analysis was done on literature. The author developed a PPP framework recommended to be adopted by the Zambian government. However, the author did not recommend the need for the development and integration of a risk management framework/ model appropriate and specific to the local situation with the ability to identify, analyze, and allocate the risks. This could strive to minimize and eliminate most of the risks highlighted in the paper presented by (Ngoma, 2015) to achieve value for money and sustainability. The need for detailed customized structures, financial instruments, and contracts meeting specific requirements for each PPP must be developed as each project are unique.	(Ngoma, 2015)
"Public Private Partnership Act, 2009"; "Public-Private Partnership (Amendment)2018"; "Public-Private - Partnerships in Infrastructure	Infrastructure funding gap in Zambia. Inefficiencies in public infrastructure development projects. Poor maintenance of the public infrastructure.	Literature review- Data gathered from the PPP Act of 2009, the PPP Amendment Act of 2018, and the Zambia Development Agency.	There is a need for Regulation and Standard guiding documents to supplement the implementation of the Acts. The legal framework does not stipulate the project strategies and the assessment technique for the performance parameters. The Act does not explicitly give guidance on the risk management aspects, thus leaving room for project failure. The importance of value for money has been emphasized in the Amendment Act of 2018 but the sustainability of infrastructure is missing.	(Zambia-Development-Agency, 2014);(Sections et al., 2009);(GRZ, 2016)

Development in Zambia”			The risk management framework/model designed to cater for both solicited and unsolicited PPPs is highly needed to increase project success.	
“Assessing Value for Money in Public-Private Partnerships Infrastructure Projects in Zambia: Case of Lusaka City Council”.	Value for money not being generated for LCC by the Luburma market project. Optimal risk allocation was not done, the bidding process was not competitive	In-depth Interviews, Literature survey, and Questionnaires	The achievement of Value for Money and the sustainability aspect must have been among the criteria in the finalization of this PPP project. Effective stakeholder engagement at the project development stage seems to have been lacking (planning and procurement), as once it is missed at this stage, there is public outcry. The risk management framework for the PPP project was not mentioned despite this procurement model being complex.	Kalemba, A. (2011)

Compiled Author (2019)

3.9 Conclusion

In this chapter, a variety of literature from different scholars was reviewed. Public-Private Partnership was elaborately elucidated and a comparison was done with the traditional public procurement method. Appreciation and application of the relevant technology in the systematic management of risk are vital for the enhancement of obtaining value for money and sustainability of projects in terms of environment, economy and community. Part B marked the end literature survey which was covered in two chapters. The next chapter analyses the conceptual and theoretical framework of the study. These guide how the different variables relate to each other to attain the ideal situation or the required condition in proper risk management of mega construction projects such as hydropower projects.

CHAPTER FOUR

THEORETICAL AND CONCEPTUAL FRAMEWORK

4.1 Introduction

This part of the thesis explains the theories and conceptual framework on which this research is based. The sections outline in this chapter draws attention to how the theories in the field of finalization and development of infrastructure through Public-Private Partnership, and the role of the risk management process at the project development stage of the project life cycle. Hence, this chapter highpoint four theories and demonstrates them according to the relationship to the topic of discussion. Postulation and critique have been done by this author on the theories adopted.

Thereafter, the chapter presents some conceptual framework cases developed by other authors followed by this author's framework development basing on the literature survey and the theories adopted. The independent, moderating, and dependent variables have been adequately explained. Finally, since this research had a component of quantitative analysis, the hypothesis was proposed and the testing method.

4.2 Theoretical Underpinning

Camp (2001), defined a theory as a scientific approach that aims to explain and enhance understanding about a particular phenomenon. Furthermore, it challenges and extends the available knowledge not exceeding the limit of hopping expectations. The theory gives an underpinning illustration of certain problems that exist. Lester (2005), agrees that well-elaborated theories and structured conceptual framework anchors as the "blueprint" for the given area of study such that it guides building and supporting the research also to appreciate the philosophy, epistemology, and ontology approach of the research as a whole. The theoretical framework has been defined (Eisenhart 1991, p. 205), as an edifice that chaperons a study through the dependence of theories formed by known illustrations of definite spectacles and relationships. Visser (2008) empirically explains that standard in research theory development is that, it should be appropriately construed and in alignment with the objectives of the study Thus, following the given explanation on the theories, Issa, Emsley, & Kirkham (2012), relates the risk management theory as the platform on which risks are systematically and technically identified, analyzed and mitigated on a sector or project.

To efficaciously comprehend the importance of a well-designed risk management framework in HPP/PPP and to predominantly address the problem identified in the statement of the problem, there is a need to establish the theoretical underpinning. Thus, this research from a theoretically exploratory and explanatory perspective analyzes the theories namely: Principle Agent Theory (Sappington, 1991; Ayee, 2005), Transactional Cost Perceptive (Koschatzky, 2017; Williamson), Stakeholder Theory (Kurniawan, 2013; Wojewnik-Filipkowska & Węgrzyn, 2019; Nsasira et al.,2013) and Contract Incompleteness (Froud, 2003; Hart& Moor, 1988; Walker & Pryke, 2008).

4.2.1 The Principal Agency Theory - PAT

Like Public-Private Partnership (Dunn, 2017), Principal Agency Theory is an interdisciplinary venture in which there is a binding relationship between two parties namely Agent and Principal. PAT is commonly used to illustrate the binding relationship factors involving delegation of authority with potential control risk to affect the sector or project(Dunn, 2017). Furthermore, these stated 'problems of control'(Tolani, 2013b) emanate from the inherently conflicting interests of principals and agents. It also focuses on the design of incentives and relevant agreements at both ex-ante and the ex-post scenarios (Chung, 2012; Brousseau, 2008). Additionally, PAT gets interests in the search for an optimal risk allocation between the principal and the agent in the contractual agreement (Ross, 1973; Holmström, 1979; Mirrlees, 1999). Thus, Sappington(1991), presumed that PAT stands on the platform waiting for judgment regarding the complexity of the project or situation so that a decision is made on whether it can be executed by the Principal or hire a competent 'agent' with the capacity and resources to implement the project. Ayee (2005), argues that the process is not as easy because finding the best agent is a major challenge encountered by principals (Demy Chung, 2012). Normally, a principal picks an agent to perform responsibilities that diverge in specialized skills, complexity, and scope which must be executed within the agreed performance parameters (Roach, 2016).

In many occurrences, the agent has been subjugated by the principal during the business deals due to the former's vulnerability status (Demy Chung, 2012), though the agent strives to manipulate the system to gain from the business partnership. As stated in the literature review, the private partner comes with the worth of more technical expertise and relevant experience in handling projects than the pubic partner (principal). Kiser (1999), deduces that economics, political science, and sociology as the intellectual evolution of agency theory.

From the preliminary information given by the researchers on the meaning and description of PAT, it plays a very valuable protagonist in unfolding risk management in PPP contracts. In terms of risks on the project, Allen and Lueck (1995), assumed that the principal is risk-neutral and the agent is usually risk-averse. Differences in risk appetite (Mccann & Busadm, 2014), in the PPP construction project, affect the concessions/agreements. Risk appetite is referred to as the quantity and risk types the party on the project can have an influence on and ready to handle in meeting the objectives (Farquharson, Torres de Mästle, & Yescombe, 2011; Sparrow, 2000). Organizations have varying risk appetites prejudiced by the technical capacity, nature of the project, organization culture, and mandates (Bosetti, 2015). In terms of the PAT, risk appetite can be related to a point of balance between risk and reward at which a decision-maker (either Principal or Agent) feels most comfortable handling the risk (Sparrow, 2000).

Furthermore, (Sparrow, 2000), elaborates that being intentionally aware and unambiguous about that point of taking up the risk, is the necessary first step in the management of risk. And from the literature review conducted by this research, there was an establishment that risk allocation (Beaudrie, Kandlikar, & Ramachandran, 2016; Sy, Likhitruangsilp, Onishi, & Nguyen, 2016), is a very imperative component of risk management as it is at this stage where the stakeholders (private and public) share the risks. The public and private partners can thus be referred to as Principal and Agent in this circumstance. However, Sparrow (2000), laments that in the absence of a risk management framework/model, it proves to be very difficult for a decision-maker to describe or explain adequately the risk allocation system. Thus, PAT sits well with this research as the component of risk allocation in the designed risk framework must be anchored on this theory. Nevertheless, (Parker et al., 2018), explains the negligence that this theory has been applied unfairly to which the principal over delegates the responsibilities and controls almost all decisions to the agent. Also, there is some indispensable supposition underlying agency theory that depicts that self –centeredness and opportunistic traits is what forms the agents such that if not checked well, the principals are bound to be exploited (Miller and Whitford, 2007). This breeds the risk known as information asymmetry (Pilcher et al., 2004; Parker et al., 2018; Nkhungulu, 2014; Oudot, 2005). Once the information asymmetry risks creep in between the agents and principals, it creates the basis for opportunism (Oudot, 2005; Shrestha, Aibinu, Chan, & Chen, 2013; Wang, Liu, Xiong, & Song, 2019). Scholars have established and recommended methods techniques to minimize information asymmetry risks (Schieg, 2008) namely;

a.) Bureaucratic control.
b.) Processing and management of information.
c.) Motivations and rewards.
d.) Business reputation;
e.) trust;
f.) Stewardship relationships.

In addition to the recommendation stated by Schieg (2008), in the adoption of best practices, there is a high need for a strong regulatory and legal framework to be championed by the Principal (Government). Established legal systems give clarity about the contractual agreement, project development stage (feasibility, planning, and procurement) and schedule of responsibilities of relevant stakeholders for the viability of the project (Pilcher et al., 2004). Furthermore, Pilcher et al., (2004) outline that there must be political commitment and effective public administration that gives confidence to the partners making huge investments. Thus, with an enlightened understanding of PAT, this research strives to establish how best the principal and agent relationship can be heightened to increase the effectiveness in the finalization of the HPP/PPP agreements. The focus of this research is on the identification of the risks that manifest within the partners and how best the allocation is done to eliminate or minimize risks at the project development stage.

There is a need to have considerable trust between the parties and regularly share the information relevant to the project (Lewicki et al., 2006). Well, enriched trusted principal and agent relationship facilitates the exchange of information, there is a need for an enabling environment where there is non over control of either party and negative opportunistic behaviour (Aubert and Kelsey,2000; Brewer and Strahorn, 2012). Therefore, in complicated construction projects like hydropower which have dynamic systems, for efficiency execution, trust between key stakeholders is cardinal. Parker et al. (2018), deduces that effective correspondence and sound relationships are inseparable and are part of the critical factors of outcome success.

There is a need to acknowledge that conflict and dispute are bound to happen on the partnership agreement (Ke, Wang, & Chan, 2011; M. Shrestha, 2011; Issa et al., 2012). Fisher (2000) defined "conflict as an incompatibility of goals or values between two or more parties in a relationship, combined with attempts to control each other and antagonistic feelings toward each other". Consequently, for this relationship to work well, the PAT must be operationalized and ensure the outlined underpinning critical success factors are implemented. PPP projects being known for the complexity and inherent risks, a very good relationship between the parties is the recipe for successful infrastructure development.

4.2.2 The Transaction Cost Theory - TCT

Rowlinson & Liang (2010), deduced that TCT infers the cost which is incurred during an exchange at the open market. However, many researchers have given various explanations of the same. North (1990) defined TCT "as the costs of measuring the valuable attributes of what is being exchanged and the costs of protecting rights, policing and enforcing agreements". Another delineation is that Transaction costs (Bruchez, 2014), are incurred during establishing and sustaining the contractual relationship, regulating services, legal and transaction advisory costs during the procurement process. To complement this definition,(Jin, 2014), explained that poorly performed risk identification and analysis raises both the capital and operating costs leading to the reopening of negotiations and the need for re-looking in the risk allocation. The author continues that such business setbacks breed opportunistic behaviour activating transaction costs (Jin, 2014). Hence, many authors have contributed that with a proper understanding of TCT, there is a high reduction of unnecessary costs associated with the contractual agreement (Mouraviev, 2012; Benes & Stary, 2009). HPP/PPP borders on a transaction between the private sector and the hoisting government. Hence, this is theory sits well with this research.

Furthermore, in an economic relationship involving various contractual agreements and open markets, factors that thwart technical specifications, the best flow of the business transaction are known as transaction costs (Thomassen et al., 2016). These authors inferred that the most contributing factors to transaction costs are the opportunistic comportment by either party on the business arrangement (Thomassen et al., 2016). Also, Chang (2013) stated that this unprincipled trait once exhibited by one party, the other party finds means of retaliating resulting in unexpected costs through dispute resolution platforms. This author presumes that in comparison to PAT, in TCT, the issue of information asymmetry risk seems to be salient in contractual obligations between the partners. This section strives to have an in-depth understanding of this theory so that the underpinning costs in HPP/PPP are minimized or eliminated through a risk model. This is imperious as unnecessary costs in the transaction if not managed well, would hinder the achievement of value for money and sustainability on the needed infrastructure in developing nations (Bruchez, 2014; Srinivasu & Srinivasa Rao, 2013; Valentine, 2008; De Marco & Jamaluddin Thaheem, 2014).

In terms of risk management, Jin (2014) advises that in PPP projects, the allocation of risks must be conducted with an in-depth understanding of the TCT theory to proactively minimize the occurrence of problems during the execution of the projects. This is in line to mitigate some inherent risks associated with PPP finalization, such as incomplete contracting (Walker & Pryke, 2008), heavy capital investment (B. Li et al., 2001a), and the complex nature of the project transactions (Ganglmair & Wardlaw, 2015). This research emphasizes a robust risk management framework that has an effective risk allocation technique to mitigate transaction costs which can harm the project objectives.

Concerning the assumptions outlined in the PAT, it is not always that the agent's acts and intentions are in the interest of the principal (Roach, 2016; A. Shrestha et al., 2013). It is on this precedent that the principal must ensure that the objectives, performance parameters, and incentives are adequately outlined to have a good business relationship with the agent (Nkhungulu, 2014). That is the reason Jensen (2003), endorses that the development of suitable performance-based incentives and monitoring techniques so that there is compliance with the negotiated terms and conditions. Nonetheless, this commercial energy tames the agent, in the long run, results in a cost for the principal (Jensen, 2003). Some of the examples of such costs as outlined by Jensen (2003) are listed below;

(i) Formulation and structuring of the contract
(ii) Monitoring and contract administration expenses
(iii) Cohesiveness factors for the agent and principal.
(iv) The residual loss due to the business relationship

Accurate measurement of costs in project transactions is imperative as an input in the risk management framework. Hence, Thomassen et al., (2016) suggest two principles, a direct measurement that depicts the cost of resources employed in the recruitment and execution of the business with the partners and the difference between the price paid by the buyer and the amount received by the seller. The author illustrates these principles below:

a.) Ex-ante transaction costs

(i) Business Enquiries and Market Surveillance Costs -This include all relevant expenses incurred in searching for the prices and availability of products or services from various sources

(ii) Negotiating Costs- These include all the expenses generated during the bargaining with business partners for the finalization of the contract.

b.) **Ex-post transaction costs**

(i) Regulatory and Enforcement Costs- These are the expenses incurred during the administration of the contract and by ensuring the business party fulfils their roles and responsibilities including necessary measures if the opposite occurs.

Koschatzky (2017), adds that the cost of a transaction within PPP seems to be under control by the principal internally, but externally it keeps on rising as the project is being implemented. In PPP projects in Norway, Thomassen et al.,(2016), stated that the due to complex nature of this model of procurement, the cost of the transaction went up to 70-80 per cent of total offering costs. United Kingdom Defense Sector PPP projects (Hall, 2015a), encountered significant transaction costs. Also, (Hall, 2015a) cited more examples of PPP projects affected by high transaction costs such as road works in Central Europe and part of Eastern not leaving about £400 million consultancy and advisory services paid to lawyers for PFI/PPP. Besides Ke et al. (2011) and Klijn & Koppenjan (2016), agrees that indecorous organizational structure and poor coordination attributes to an increase in transaction cost on complex contracts. However, the contrast was established that though the PPP projects incurred high transaction costs, Norway produced high-quality infrastructure that meets stakeholder's expectations. Thus, it cannot be presumed as all the transaction costs are a loss. Thus, this research strives to develop a risk framework that can mitigate the risks in PPP projects, support an efficient procurement process, reduce transaction costs, and improve contractual performance. (Nasieku, 2016), deduced that sound risk allocation achieves management efficiency and reduces transaction costs.

4.2.3 The Stakeholder Theory –ST

Stakeholder theory as popular as it, contributes significantly to the success of implementing HPP/PPP through in-depth identification, comprehension, and classification of key stakeholders (Wojewnik-Filipkowska & Węgrzyn, 2019). The attributes and contributions of the stakeholders are very cardinal in the evaluation of the PPP project (Osei-Kyei & Chan, 2017a; Rajablu et al., 2017; Kurniawan, 2010). Consultants, transaction advisors, contractors, the hosting government, financing institutions, and the general public forms part of the main key stakeholders on PPP projects (Olele, 2003; Yuan et al., 2010). Thus, technical inputs for the risk framework being developed by this research strive to incorporate the relevant key to stakeholder's perception. The European Commission (2013), states that the perception about the government on PPP is public benefits while the private sector is profitability. From the analysis by the European Commission, this author raises a question on how best a win-win situation can be attained on a PPP project. Grimsey and Lewis (2004), laments that the effective supervision of the project by the public sector as a stakeholder leads to the attainment of total benefits of PPP projects such as social–economic and environmental effects enhancing sustainability.

Furthermore, for project managers to effectively manage various stakeholders, there is a need for a full understanding of the underpinning strength of each one of them. That is the main purpose of the stakeholder’s theory (Ketokivi and Mahoney, 2016), which has also been applied to many other disciplines apart from strategic project management (Wu and Wokutch, 2015; Moldogaziev, 2016). From the various perceptive expected by stakeholders and their varying interests, there are inherent risks that must be effectively identified, analyzed, and mitigated. This is the main objective of this research though it inclines at hydropower projects. Wojewnik-Filipkowska & Węgrzyn (2019) further contribute that embracing a strategic approach to the concept of stakeholder theory can greatly attribute to the attainment of the project objectives if properly harnessed.

The principle of stakeholder fairness (Harrison and St John, 1994), confirms that parties involved in the agreement where all benefits in it have been negotiated and accepted by the parties, then the obligation set must be adhered to. However, Blattberg (2004), criticized the stakeholder theory that there is some assumption that the interest of some parties to the agreement is compromised or balanced with other interests.

Braeckman & Guthrie (2016), states that a lot of research puts more effort into how the project cost, construction delays, and economic risks affect the project developer or sponsor, however, the social-economic and environmental effects on some stakeholders are infrequent. This leverages the importance of identifying the risks which can be encountered in the absence of effective stakeholder engagement. Besides Xiong (2017) states that there are critical risk circumstances in affecting PPP infrastructure project stakeholders due to risk tolerances they possess that leads to more claim demands and compensation. Furthermore, Xiong (2017), alludes that this heightens negotiations by the stakeholders and in some cases project terminations which subsequently leads to public interest being affected.

There is a need to appreciate that in this case of stakeholders on a PPP project, risk tolerance refers to (Newell & Grashina, 2004), to the point when the stakeholder's capacity can bear the risk effects or the point at which risks are acceptable. And Project Management Institute (2000), defines risk tolerance as a threshold or contract emergency. Several risk situations have led the public sector to renegotiate (Berezin, Sergi, & Gorodnova, 2018; Delmon, 2012) or terminate many PPP infrastructure projects (Berezin et al., 2018; Demirag, Khadaroo, Stapleton, & Stevenson, 2012). For instance, in the United Kingdom, renegotiations occurred in 33(%) per cent of PFI projects (2004 and 2006), and with a 17% change in the estimated initial cost leading to a loss of about £4 million per year (Hall, 2015a).

Another example is in Latin America and Caribbean countries (Lee et al., 2018a), where renegotiation phenomena are persistent as projects are abandoned due to stakeholders' poor adherence to the agreed contractual responsibilities. Non –adherence to contractual obligation is so common to the extent of being declared the major problem for international firms (Nose 2014). And this is triggered by the attainment of risk tolerances by stakeholders. That is the reason, this research endeavours to design a risk framework with efficient strategies inputs with regards to the risk tolerances and effective stakeholder engagement. This component is desired to be incorporated at the risk allocation stage of the framework.

4.2.4 Contract Incompleteness Theory –CIT

The professional relationship in mega construction projects is mostly destroyed by project conflict degeneration into protracted disputes and this has been described as probably the most difficult and controversial matter (Walker & Pryke, 2008; Banwell, 1964). These conflicts and disputes (World Bank, 2015; Zou et al., 2008; Tembo Silungwe, Chiponde, Mutale, & Michello, 2015) on the construction projects has led to destructive claim impacts (Scott and Harris, 2004), and it provides that significant claims contribution to *ex-post* costs. Thus, this research seeks to disentangle networks of principal cause-effect interactions between the degree of contract incompleteness and contractual claims. In tackling this issue, this author firsts explores the theory of contract incompleteness and how best this can be avoided on a PPP agreement/concessions. The contract drafting is done at the procurement stage which falls under the project development stage of which this research visualizes to ensure there is a robust risk management framework. Fully, understanding the theory contributes greatly to designing a robust model to effectively and efficiently tackle the related risks of contract incompleteness.

In the analysis of this Contract Incompleteness Theory (CIT), some questions revolve in this author's mind with regards to what leads to contract incompleteness. Great enough, Saussier, (2000), clears the mind of this author by stating this risk (incompleteness) is attributed to parties trying to curtail project costs. Saussier (2000), further states that the incompleteness of the contract is a pure internal choice by the party and cannot be attributed to a badly designed contract. Ganglmair & Wardlaw (2015), contribute that a complete contract specifies the rights and duties of each party on the contract. Meanwhile, it is usually infeasible to cover the entire contractual conditions (Ganglmair & Wardlaw, 2015), gaps must naturally or strategically arise in which the contract parties are subject to ex-post bargaining or inefficient ex-post transactions cost. Baker & Krawiec (2006), states that illogically, contracts always have some areas of concern regarding completeness. Similarly, some stakeholders deliberating and purposefully do not have the initial intention of giving out the full needed information (Dunn, 2017; Shrestha, 2015; Roach, 2016), to complete the contract. Some parties to the contract calculatingly defer the agreement to a later date (Baker & Krawiec, 2006). Nevertheless, (Omri Ben-Shahar, 2004), argues that contracts are always mandated to be complete for them to be enforceable in the courts of law. Another argument (Kosnik, 2014) is that some tradeoffs are discussed for the contract to be flexible for any future practice due to changes in situations.

This means it is an engrained delinquent within the contract management system. When measuring a well-drafted contract with an incomplete contract, it inters that the latter does not account for the critical variables (Saussier, 2000). Does this author understand why well experienced economic agents sign such contracts? However, (Schwartz, 1992; Salanié, 1997), explains that this could be because of the restricted level-headedness of transaction advisors and economic agents coupled with the corruption surrounding PPP projects (Suđić et al., 2017); Zhang, Chan, Feng, Duan, & Ke, 2016). Hence, this risk of contract incompleteness must be identified at the procurement stage and mitigated to avoid future problems. An example of the contract incompleteness case (Kosnik, 2014), is the United States hydroelectric projects between the period 1977-2007. The case was on the tradeoff between flexibility and rigidity in the drafting of the long contracts. The hydropower projects exhibited a lot of flexibility due to asset specificity, environmental, and large capital costs of projects. Thus, the drafting of the contract analysis allows some wording to reflect the flexibility of the document for any future changes.

The theories discussed have given a platform to reflect a lot of inherent risks that surround the PPP projects and typical examples of projects which encountered the same. The section illustrates conceptual frameworks including one for this research.

4.3 Conceptual Framework

The framework discussed and subsequently developed by this author is based on an all-encompassing literature review in PPP and risk management, the identified variables and the theories elaborately presented in section 3.2 to aid the analysis of the topic and respond to research questions (Andrade & Loiola, 2013). A Conceptual framework demonstrates the connecting activities of the independent, moderating, mediating, and dependent variables together (Rajablu et al., 2017; Shipuku and Mbithi, 2017). The literature survey and the theories presented by this research gives impetus to derive the conceptual framework for the study. Camp (2001) and Peshkin (1993), support this motion by describing the conceptual framework like that which establishes possible planned action of the research or an approach to a hint espoused by the researcher. The theoretical framework was included in the Conceptual Framework to solidify and elucidate the corresponding framework. Therefore, this research presents about three conceptual frameworks formulated for related PPP projects in construction and their relevant importance.

4.3.1 Risk Management in Nigerian Housing Industry – Conceptual framework

Though this research is on hydropower projects finalized through PPP, it is of benefit to extend the discussion on how in other mega construction projects, the risks are managed. Thus, the discussion is in this section on how the conceptual framework was used to analyze the risks in the housing projects (Yakubu & A. Anigbogu, 2016a).

It has been established that constitutes of the PPP procurement models are collaborations among the key stakeholders such as private parties, government, and relevant third parties(Personal, Archive, Nsiah-Asare, & Prempeh, 2016; Almarri & Blackwell, 2014; Tshombe & Molokwane, 2016), in joint decision-making (Anvuur & Kumaraswamy, 2006; Saaty, 1987; Suđić, Ćirović, & Mitrović, 2017), resource commitment (Dubini et al., 2012), sharing of responsibilities (Yakubu & A. Anigbogu, 2016a), risks and benefits (Xiong, 2017), comparative advantage (Nkhungulu, 2014) and division of labour (Tolani, 2013a). Yakubu & Anigbogu (2016), confirm that in the case of the PPP housing project in Nigeria, there was evidence of stakeholders having dissimilar organizing cultures and principles which played a critical role in terms of comparative advantage (UNHCS, 1993 and Silvester & Araujo, 2012).

It is on this basis that a conceptual framework for the Nigeria PPP housing project was developed in triple stages depicting the PPP characteristics and risk management as presented in figure 4.1.

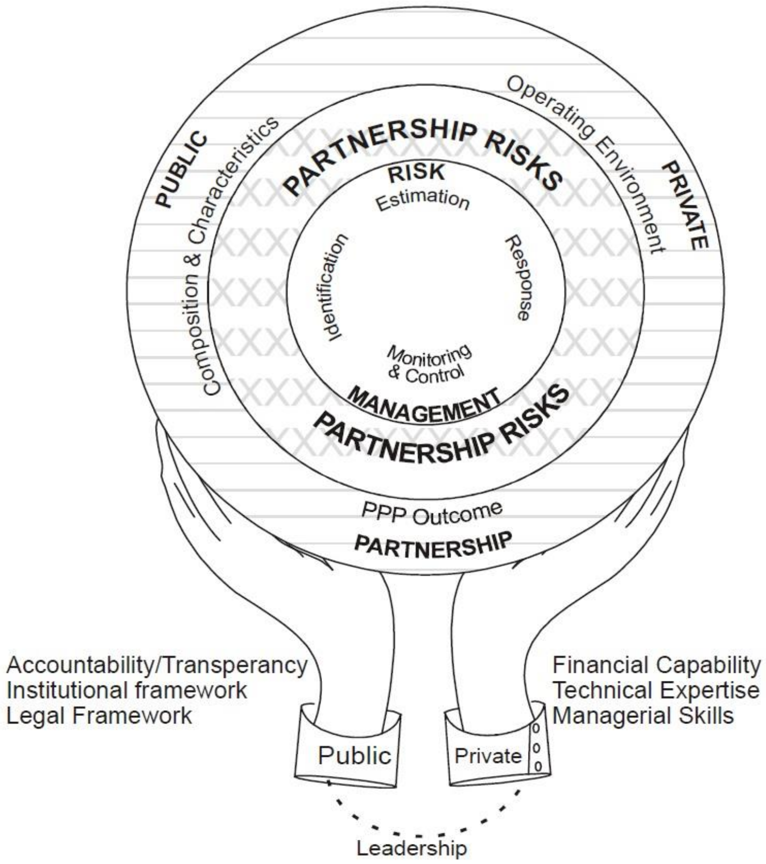

Figure 4. 1: Conceptual Framework for Managing Risk – Source :(Yakubu & Anigbogu, 2016a)

There are some connections of this conceptual framework with this research as it depicts the important schedule of responsibilities of the public and private parties to the PPP which enhances risk allocation. Also, the Stakeholder Theory and Principal-Agent Theory are applied to this conceptual framework. The particular framework strives to ensure there is effectiveness and efficiency in the managing of the risks on the PPP project and this is attained by establishing the roles to be played by the relevant stakeholders.

4.3.2 Assessing Value for Money (VfM) in PPPs - Conceptual Framework

Balkans (2018), elucidates that VfM assessment is frequently used by public authorities as a decision-making tool (Kashiwagi & Kashiwagi, 2012; Accenture, 2015), in PPP projects. Also, Engel et al. (1990) contribute that the premium placed on a product or service by the purchaser is known as a value, or the meeting of the objectives outlined in the agreement by the parties (Samuel Olusola et al., 2017). It can be deduced that the VfM assessment identifies the delivery decision on balancing risks measured with costs. The attributes to the accomplishment of value for money in PPP projects include competitive spirit, technical and innovative skills, contract duration, performance parameters dimension, and incentives (ibid, 2011). To achieve this, an enabling environment that is sprightly with robust legal and regulatory including the institutional capacity framework is imperative. It is these mentioned factors that this author attempts to incorporate to narrow the gap in poor PPP projects delivery.

Ameyaw, Adjei-Kumi, & Owusu-Manu (2015), expounds that there have been some attempts to develop conceptual frameworks for VfM. These include road projects in the UK finalized under PFI (Akbiyikli, 2006), power generation projects in Asia (Gigih and Colin, 2014), and construction projects in Malaysia (Takim et al., 2009). However, a perilous review of the existing frameworks showed several inadequacies in VfM conceptual frameworks developed (C. Ameyaw et al., 2015) including omission of the stages of the project cycle outlying the importance of VfM. Furthermore, discoveries from previous PPP project reviews were not put into considerations to solve the inherent problems in VfM assessment (C. Ameyaw et al., 2015). Ameyaw et al., (2005) raised a cardinal point which construed from these findings that it is not easy to replicate or simply adopt any generic VfM frameworks developed by other countries and use them for any projects in any country due to the differences in the business environment. Grout (2005) and Alfen et al., (2009) firmly agrees as a PPP project's success varies due to different hosting nation's business environment. This prompts this research to ensure that all the economic and environmental factors in which the desired risk model is domiciled are incorporated to minimize or eliminate the risk of developing a risk framework which is a white elephant (Sobják, 2018; Fombad, 2013; Hodge, Greve, & Boardman, 2010). In this research, the 'white elephant' risk framework refers to the one that fails to meet or exceed the objectives of its existence. A well-designed risk framework is envisaged that once it is fully developed, it shall contribute highly to the attainment of Value for Money in PPP projects as this is the desire by almost all governments (Malinovitch, 2004).In pursuit of this, the developed risk management framework is planned for evaluation and validation.

4.3.2.1 Critical Success Factors that influence the VfM Framework

Appropriate identification and efficient risk allocation on the PPP project are among the driving factors in the designing of a VfM framework (Olusola et al., 2017). As per the best practice (C. Ameyaw et al., 2015), the fundamental value in PPP projects is that the responsibilities must be given to the party with the capacity to manage the risks well. In an event of poor identification and ineffectual risk, allocation leads to poor risk management resulting in non-achievement of VfM (Burger and Hawkesworth, 2011). A highly competitive process in the selection of the private party is another critical factor to enhance the VfM framework (Zack, Ccm, & Executive Director, 2009; Hodge et al., 2010; Olusola et al., 2017). From this analysis, it is then, comprehensible to proclaim that competition is a factor of VfM. The competition of the bidders is handled at the procurement stage of which is part of the project development stage as per this research. Furthermore, simplicity in the pronunciation of the schedule of responsibilities in a PPP agreement is fundamental for each party to understand their contribution under the contract as it influences the attainment of VfM (Grimsey and Lewis, 2005). More another factor that can hinder the achievement of VfM is the poor understanding of the transaction cost theory (refer to section 3.1.2) which are not predictable due to the high level of sensitivity of PPP projects and the flexibility aspect of the project contract costs (Pitt and Collins, 2006).

Finally, Grimsey and Lewis (2005) identified performance measurement as among many factors that influence the attainment of VfM. The author supports this statement by explaining that the VfM is directly correlated to the performance measurement systems on PPP projects. Figure 4.2 depicts a theoretical framework developed by (Ameyaw et al., 2015), on value for money (VfM) assessment methods in Ghana's PPP projects. While figure 4. 3 presents the conceptual framework showing the factors needed in the attainment of the Value for Money adopted from (Kalemba, 2011).

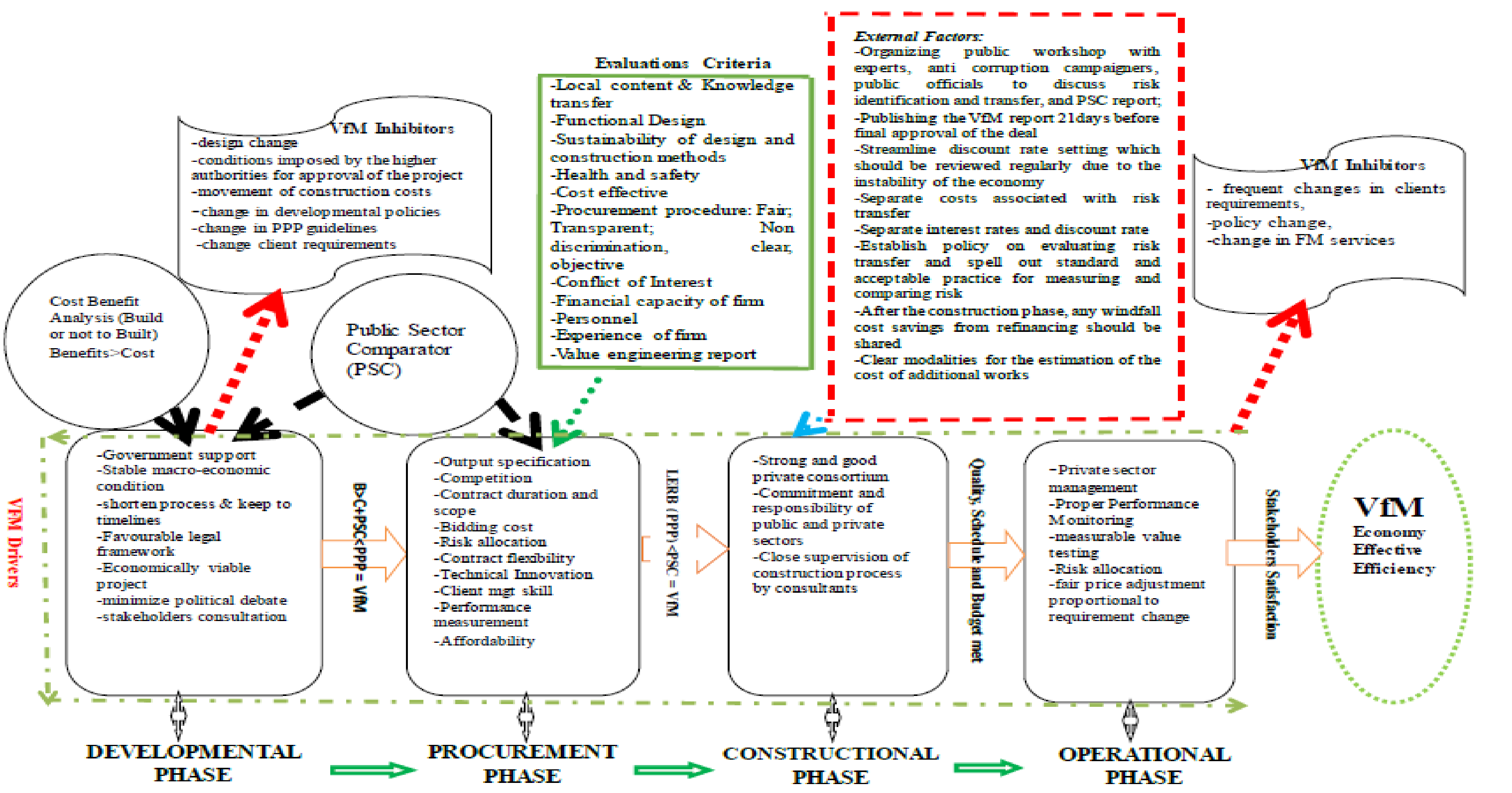

Figure 4. 2: Value for Money (VfM) Theoretical Framework at all Project Cycle Stages – Ghana (Ameyaw et al., 2015)

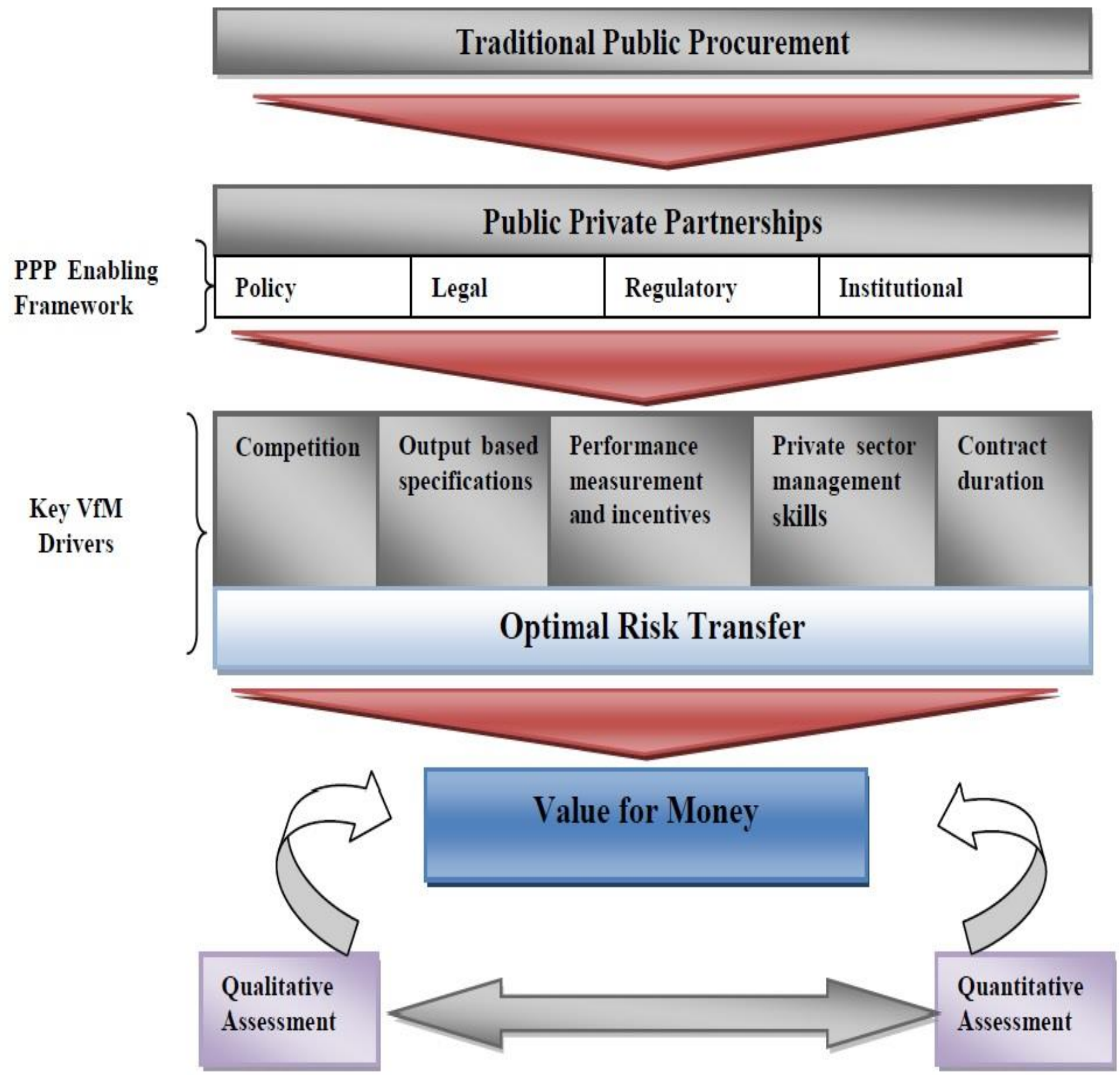

Figure 4. 3: Value for Money Assessment in PPP -Conceptual Framework. **Source: (Kalemba, 2011)**

Figure 4.3 illustrates the factors which must be present in the attainment of Value for Money for HPP/PPP projects. An enabling environment that consists of a well-grounded PPP policy, legal and regulatory framework including string institution capacity attributes to the attainment of Value for Money (Berezin et al., 2018). The optimal risk transfer plays a vital role to achieve the VfM. The fundamental principle of promoting PPP models value for money can be obtained through optimal risk transfer rather than maximum risk transfer (Commission, 2017).

4.3.3 Conceptual Framework for this research

This research endeavours to develop a risk management framework for HPP/PPP with the aptitude to identify, analyze, and allocate risks to a suitable party on the agreement. It is envisioned that the designed framework intends to provide a systematic approach to project developers, governments, project financing institutions, consultants, and academicians in the identification, analysis, and allocation of risks in the PPPs mega construction industry and particular hydropower projects.

Accordingly, in contributing to the designing of the framework this research develops first a conceptual framework by getting the insights from the statement of the problem, literature review including the theories discussed in this chapter. The conceptual framework has three categories of variables namely; Independent Variable, Moderating Variable, and Dependent Variable (Rajablu et al., 2017; Adam, 2019; C. Li & Stacks, 2016). A variable takes on diverse values and it is not constant (Toledo-Pereyra, 2012; Bhopal, 2002).

Flannelly et al., (2014), explains that the independent variables are constant and have abilities to control or change the expected results (dependent) in a cause-effect relationship (Namazi & Namazi, 2017). The dependent variables are those that are influenced by the independent variables or measured in an investigation (Creswell, 2014). Then the moderating variable (Flannelly et al., 2014), changes the relationship and strength between the independent and the dependent variables (Wang et al., 2019). The conceptual framework shown in figure 4.4 illustrates how the variables interact.

Conceptual Framework –Risk Management on PPP Projects

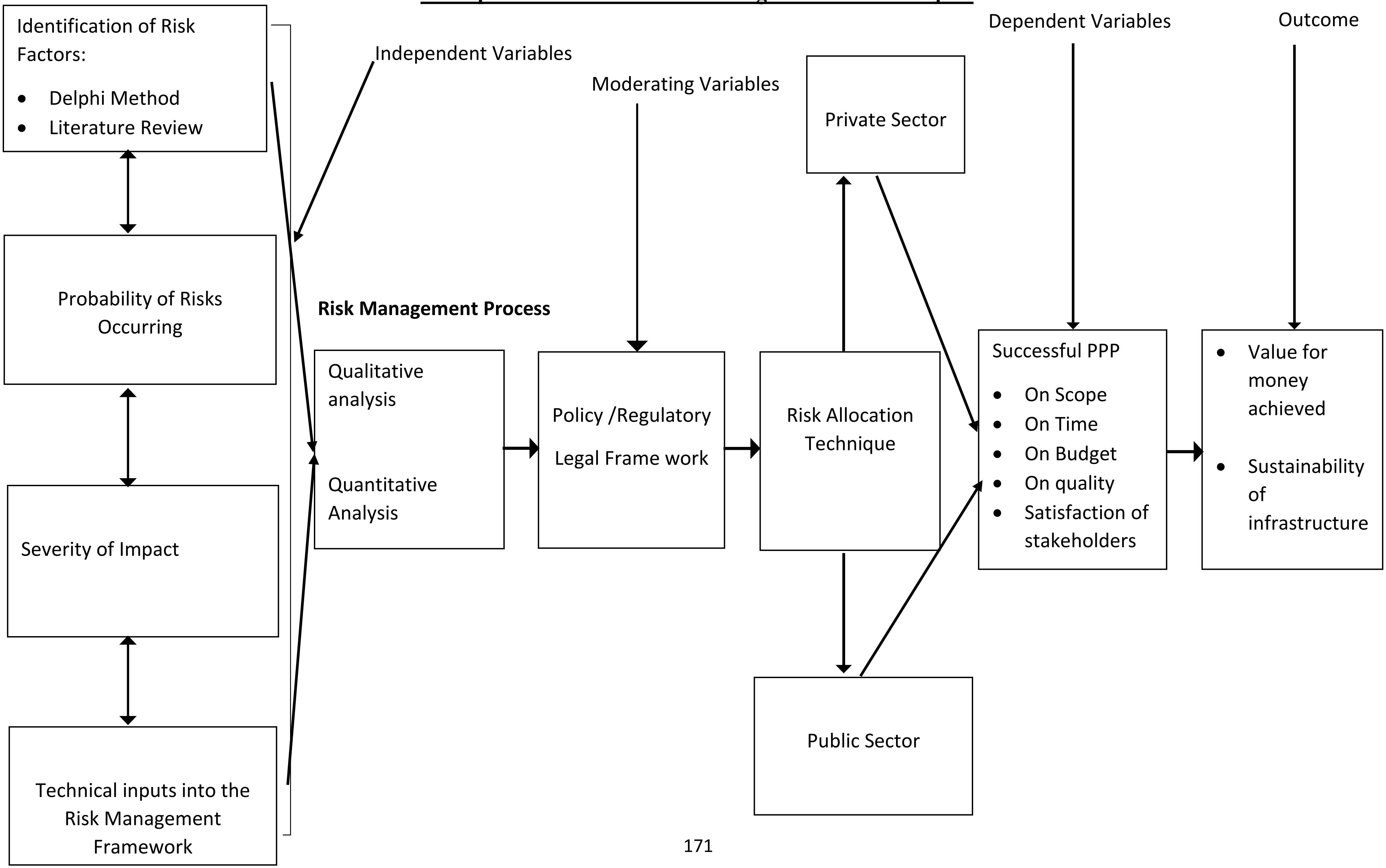

Figure 4. 4: Conceptual Framework- Source: Author(2020)

Figure 4.4 represents a skeleton conceptual framework for the study which provides inputs into the risk framework this research attempts to develop. The framework illustrates the following:

4.4. Significance of Variables

4.4.1 Independent Variables for the research

a.) Identification of risk factors at the project development stage.

Risk identification (Yakubu & A. Anigbogu, 2016b), is a paramount stride in the management of risks as the organization can only manage if it is known what risks it faces. This is carried out at both development and throughout the project up to the commission stage for enhancement of achievement of the objectives (Osei-Kyei & Chan, 2017; Haseeb, Bibi, Qureshi, & Khan, 2014). The methodology to identify the risks adopted for this research is Delphi Technique(Hora, 2009; Sharma & Kar, 2018) and Literature Survey(Li, Akintoye, & Hardcastle, 2001; Birla & Taneja, 2012). The justification for this variable is that only identified risks can be minimized or eliminated. Thus, if the risks are not identified in the first place, then the project manager is simply "gambling". Furthermore, the success of the PPP construction projects is highly influenced by the proper identification of the risks which can negatively affect the intended objectives (Yakubu & A. Anigbogu, 2016b; Jin, 2009; Nadaf, Nadaf, Jamadar, & Thejaswi, 2018). The PAT, TCT, IC and ST theories discussed in the earlier section of this chapter all indicate the need for the potential risks which are inherent in PPP projects. The identified risk factors include technical, contractual, financial, environmental and social, legal and regulatory risks including economic risks.

b.) Probability/Likelihood of Occurrence

The analysis stage of management of risks encompasses defining the probability of occurrence and severity of the impact of each identified risk (Stefan, 2014; Pribadi, Soekirno, & Husnullah Pangeran, 2006). Comprehensive knowledge about the likelihood of the risk occurring is very cardinal to the project stakeholders as it enables quick preparation, prioritization, and building capacity to handle the risks (Likhitruangsilp, Do, & Onishi, 2017; Dumbravă & Vladut-Severian, 2013). And PMI (2004) further explains that prioritizing the risks leads to classifying the risks in terms of high, medium, or low for it gives a platform to appreciate the level of attention that can be given to other risks on the project (HM, 2004). The determination of both probability and impact can be assessed using either a workshop, a checklist of risks, Delphi, or data from past projects (Balkans, 2018). Therefore, this variable is critical to this research as to carry out effective risk analysis, it is imperative to do a qualitative assessment on the probability of occurrence and the level of impact of each risk (Sastoque et al., 2016).

c.) Risk Severity

Determination of the risk impact after establishing the likelihood of occurrence on the objectives completes the process of analysis (Osei-Kyei & Chan, 2017; Kakati & Dean, 2016). Irem Dikmen & Birgonul (2004), illustrate that to obtain the risk ranking, the severity of the risks must be multiplied with the probability of occurrence of each identified risk factor. This author infers that proper analysis and appreciation of risk severity give accuracy in understanding the risk effect on cost, schedule, quality, and project status. Besides knowing the severity completes the process of assessment. The importance of this variable is that it ensures additional strategic techniques are put in place to manage the risks which are considered to be more hazardous to the project objectives.

d.) Technical inputs in the Risk Management Framework

(i) **Technical Project Proposal Appraisal:** This is a critical input at the HPP/PPP project development stage (Delmon, 2012; Charoenngam & Kurniawan, 2015). The techno-commercial adjudication is imperative as it gives the relevant information to project sponsors, developers, client's consultants, and many stakeholders on the value and variability of the project.

(ii) **The Experience of Stakeholders:** (power, interest, urgency, legitimacy, proximity, and networking) and Institutional Capacity (Eberhard et al., 2016; IHA, 2019). This input is cardinal as this data must be known to avoid project failures (Ke et al., 2010). There is a risk of project failure in the event the stakeholders are not familiar with the PPP models. As appreciated from the previous chapters, PPP is a complex and long term contractual project. This entails experience that is highly needed to finalize these concessions. The institutional capacity plays a critical role as well, as the insufficient capacity of the institution is the breeding ground for all the risks that attributes to project failure.

(iii) **Private Party Appraisal and Due diligence:** This looks at the Special Purpose Vehicle to be used on the project (Hall, 2015b; Owen, 2016). Do they have technical experience?

How many similar projects have been handled before? What is the quality of infrastructure developed in the past by this party? How is their financial prudence? These data once gathered play a critical role to decide on the private partner coming on board.

To have a highly practical effective framework, there is a need for technical inputs as observed in the literature review established knowledge gaps to be incorporated. This enhances the effective operation of the risk management framework to contribute to the desired maximum output and subsequent outcome.

4.4.2 Risk Management Process

The identified risks are then qualitatively and quantitatively analyzed so that the risk significance is established. The likelihood of occurrence and impact of the objective of the risk is established so that the stakeholders get the idea of which party can be responsible for the particular risks (I. Dikmen et al., 2008). This process operates as the engine of the framework to enable effective and efficient allocation of the risks to the suitable party with sounding economic and technical capacity to manage the risks. This process has been adequately illustrated in the literature review (refer to chapter 2).

4.4.3 Moderating Variable- Legal Framework and Institutional Quality

Legal Framework and Institutional Quality – this refers to rules, norms, and strategies of a situation that can moderate the effects of government support on private investments in PPP projects (Ostrom 1990; North 1991; Brown, Potoski, and Van Slyke 2006). Institutions provide enforcement mechanisms for agreements, penalties for reward, and punishment to enhance the effective implementation of programs/projects (Hall and Taylor 1996). In an event where the government has good governance, there is a high level of institutional quality which includes adherence to the rules of law, contract enforcement, and judicial independence (Perocco, 2014; Kaufmann et al., 1999; Kaufmann, Kraay, and Mastruzzi 2011). The governance environment (Wang et al., 2019) is the degree of rules and requirements that have been established by individuals and organizations. In this research, the legal framework includes; PPP Policy, PPP Act 2009 (Including PPP Amendment Act, 2018), ZPPA Act, PPP Department, and any other legislature surrounding the PPP Agreements. Daude and Stein (2007) imply that the rule of law, government effectiveness, and corruption control are relevant to institution quality as they can measure the extent to which the government can govern economic and social interaction rules among partners, and fairly implement rules.

4.4.4 Mediating Variable - Risk Allocation

The identified and analyzed risks must be appropriately distributed to the PPP participants. The literature has reviewed that the vitality of the responsibilities held by the parties in the PPP project life cycle, the greater risks they have to bear. Thus, equitable and reasonable risk-sharing among parties is very significant (Bing et al., 2005). This is a very crucial component as a lot of work has to be done to ensure the party allocated the risks that can handle it. Thus in addition to the theories outlined at the beginning of this chapter, allocation of the risks on a construction project invokes cooperative game theory (Peckiene et al., 2013). The theory is highly applicable to this research as it relates to having well-designed decision making in cooperation with other stakeholders with varying interests.

Wang et al., (2019) illustrate that the reason the government sector enters into PPP agreements is the sharing and transferring of the risks to the private sector. The quality of PPP is determined by effective allocation, transfer, and management of project risks (Burke and Demirag, 2017; Girth, 2014). The attraction of private investment and the subsequent success of PPP projects is highly attributed to a smaller degree of risk misallocation (Ke et al., 2009). Risk-averse is what characterizes project developers and investors. The degree of certainty on return on investments is achieved when there are fewer risks (Wang et al., 2019). Hence, in this research, Risk allocation among public and private sectors is a prospective mediator in the execution of the PPP projects

4.4.5 Dependent Variable – Successful PPP Project

This is resultant of the process. It is envisaged that the successful PPP (Hotel et al., 2011) with the following characteristics is produced; on scope, on budget, on time, on quality and satisfied stakeholders (P. Partnerships et al., 2013). This is only achieved if the entire process has been done perfectly.

4.4.6 Outcome

The successful PPP in a nation entails the achievement of VfM (Ameyaw et al., 2015) and the sustainability of projects (Wojewnik-Filipkowska & Węgrzyn, 2019).

The conceptual framework has attempted to provide the inputs to the risk model which the research strives to develop after the whole data collection and analysis have been done.

4.5 Hypothesis

1. The alternative hypothesis (H**a**): Application of a well-defined and formulated risk management framework in PPPs agreements leads to successful project execution.
2. Null hypothesis (H**o**): The application of a well-defined and formulated risk management framework in PPP agreements does not lead to successful project execution.

Chi-Square Test from the SPSS package is envisioned to test the hypothesis for this research as it is widely used in the testing of relationships between categorical variables (Linstone & Turoff, 2002). It tests the statistical significance of the observed relationship concerning the expected relationship and the expected distribution of data (Hillson & Hulett, 2004). The chi-square has been used in various research in PPP projects to mention but a few such as assessing the critical success factors (Osei-Kyei et al., 2017), in determinants of PPP projects (Yehoue et al., 2014), comparison of the outcomes and the cooperation quality in PPPs (Warsen et al., 2018b), risk allocation in PPP projects (Tolani, 2013a) and risk management framework in market projects privately financed in Nigeria (Awodele, 2012).

4.7 Chapter Summary

The chapter has laboured to present some theories and conceptual frameworks related to this research and some areas of application. It has been reviewed in all the theories, that failure to understand the particular theoretical underpinning, its association with the PPP construction projects and the best practice, possesses as a risk to mitigate the inherent risk. It was thus observed that the design of a risk management framework should incorporate all the relevant theories and the conceptual framework. The conceptual framework was formulated with the literature survey conducted by this author. The variables included in the conceptual framework have been elaborately presented in this chapter. The chapter ends with the research null and alternative hypothesis for this study.

CHAPTER FIVE

RESEARCH METHODOLOGY

5.1 Introduction

This chapter elucidates the method that was used when conducting this research. Ojo (2003), explains that research methodology should follow the validated rules and procedures to be applied during the research and appropriate evaluation of the knowledge claims. The chapter explains the research approach, research design, the philosophy of the study, data collection tools, study population sample size, sampling techniques, data analysis, reliability, and validity. In more detail, this author outlines the research strategy. The research approach and methods for this research have been evaluated about their strengths and limitations. The steps involved have been expounded in detail and systematically outlined to ensure a high level of reliability and validity including ethical considerations.

5.2 Research Approach

The study indicated the need not only to understand the context in which the inherent risks in mega construction projects such as hydropower affects the project in terms of probability of occurrence and impact on the objectives but also the techniques in the designing of the model to manage the risks. Thus, the philosophy adopted for this research is a pragmatic worldview (Cherryholmes, 1992; Patton, 1990). The pragmatic worldview (Toledo-Pereyra, 2012), further explains that it is not based on a single approach of matters or prescribed conditions as it enables the research to use multiple methods and experiments to test causal theories making it post-positivism (Awodele, 2012; Mccann & Busadm, 2014). Patton (1990) states it is concerned with applications regarding what works and it does not focus on methods but uses all possible deterministic techniques to confirm the claim and solve the problem (Lengwe, 2014; West, 2011; Rossman & Wilson, 1985). This research strived to confirm the applicability of the risk framework and its effectiveness to solve the project failures associated with HPP/PPP.

Creswell (2014), agrees with other scholars about pragmatism not being a limited single stereotype of philosophy and reality, but applicable to mixed methods comprising of both quantitative and qualitative approaches in research. This entails that the researcher does not only select either qualitative or quantitative means to collect and analyze the data but both of them (Kothari and Garg, 2014). Creswell (2014) justifies that this approach is suitable to fully comprehend the problem-solving situation. HPP/PPP being complex and long term projects with the need to embrace the best practice of conducting research, this research stood in a good position to use the exploratory sequential mixed-method approach. This inters that this research started with qualitative techniques then moved to quantitative techniques guided by the research objectives. This is in agreement with Saunders & Lewis (2012), that the research objectives and questions are the greatest determinants in the approach applied.

There is a belief that the world has certain facts that need to be discovered quantitatively and also various realism and individual perceptions that must be construed qualitatively. Creswell (2008), summarizes that if the research calls for testing of theories, the examination of the relationship among the variables and analyzing the same using statistical procedures, is quantitative research. And where the researcher deduces the knowledge claims from basing the same from the perspectives of the constructivist is qualitative research (Creswell, 2003). Since this research involves both components, it is thus referred to as exploratory sequential mixed method research (Berman, 2017; West, 2011; Toledo-Pereyra, 2012).

5.3 Research Design

The illustration of the technical procedure of linking empirical data to the objectives and research questions is referred to as a research design (Toledo-Pereyra, 2012; Subedi, 2016; Yin,2003). This author understands it as a technical plan the researchers adheres to during the process of gathering data, analysis, interpretation, and presentation of the same. This research is envisaged to address the problem identified in section 1.6 and answer the research question outlined in section 1.6.2. Since, this is an exploratory sequential mixed method (Guttman, & Hanson, 2003; Creswell, 2004), the initial phase was carried out qualitatively through the exploring of the views of participants. Thereafter, data was analyzed, and the information was used to build into a second quantitative phase.

The researchers Creswell et al., (2003), states that it requires the consideration of three critical issues namely priority, implementation, and integration in selecting the research design. Safaie et al., (2018), expresses priority as to what specific approach is to be taken, either quantitative or qualitative so that the emphasis is given. And the priority is closely connected with the types of research questions such as “what” and “how” in qualitative studies or “if” in quantitative studies. Secondly, the implementation determines the sequence of data collection and analysis either quantitative or qualitative and sometimes it could be done in parallel. Finally, integration refers to the stage when researchers strive to mix or connect the data after the data collection process (Berman, 2018).

To operationalize the explanation given above, this research began with the first identification of the risks (qualitative), followed by risk analysis (quantitative) and thereafter development of the framework (integration) by using the collected data. However, this author was cognizant of some challenges in such a design that included obtaining appropriate qualitative data and selection of sample sizes (Toledo-Pereyra, 2012; Creswell & Plano Clark, 2011; Yin, 1994). Nevertheless, these challenges were tackled as the strength of mixed methods was in the complementary strengths and cushioning the weaknesses exhibited by either of the method (West, 2011; Johnson and Turner, 2003). Figure 5.1 briefly exemplify the explanation given about the exploratory sequential mixed method.

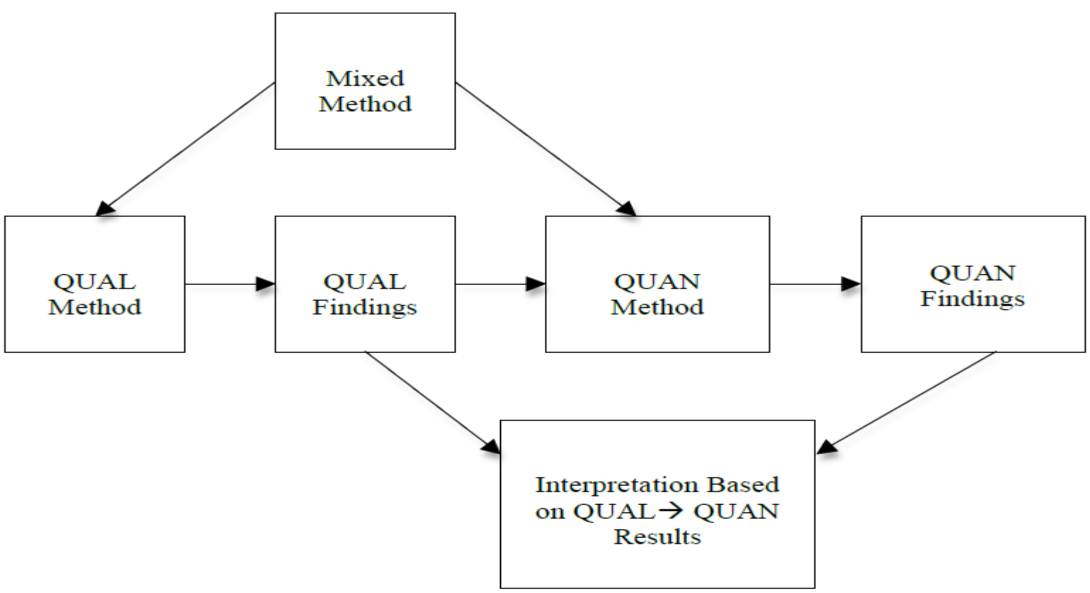

Figure 5. 1: Exploratory Sequential Mixed Method: Source:(West, 2011)

5.3.1 The research strategy

5.3.1.1 The Delphi Technique

This research employed the Delphi technique in managing the first two objectives of the study. This is the use of experts in a certain area of expertise in a study (Effah et al.,2016). Keeney *et al.* *(*2011), states that the Delphi procedures must consist of at least three rounds of the survey to have full confidence in the process. The research strategy employed to support the proposed technique, entailed undertaking an extensive literature review to gather as much evidence regarding PPP construction projects, associated risks, and particular cases of hydropower projects (refer to chapter One and two-Part A & B). As hydropower construction projects are complicated, the selection of this technique was in agreement with Chan et al., (2001), who emphasized that the Delphi technique, must be applied to solving complex problems as it brings onboard experts to build a consensus on a certain subject

However, there have been some arguments that sometimes there are disagreements on the findings due to the unsuitable design and execution of the technique (Ameyaw et al., 2016). Some of the known challenges include the poor design of the survey instrument, poor verification of the selection criteria for the experts, poor analysis of the collected data, and poor responses by the chosen experts (Gupta, Clarke 1996; Keeney *et al.* 2001). Nevertheless, (Hallowell, Gambatese 2010b) argues that the Delphi Technique is still a very useful tool due to its integration of experts in soliciting objective data and empirical evidence on research. Okoli & Pawlowski (2004), stresses that this technique has been highly used in PPP construction project research during the identification, analysis of risks, prioritization, and decision-making with regards to risk allocation.

5.3.1.2 Steps on the Delphi Process

The selection of the experts was based on the criteria outlined in this section at the end. The list selected was verified with the help of the research supervisors. Round One (1) of the Delphi technical was triggered after an extensive review of the literature. This round had a checklist for the risks associated with HPP/PPP Pre-Concessions at the project development stage (*Project Feasibility, Planning, and Procurement)* for the experts to tick in which stage is suitable for them. Also, the experts were expected to allocate the risk to a suitable party. The first round was to answer to the first and second objectives (refer to 1.8.1a and 1.8.1b). The third objective (1.8.1 c) was answered by developing a separate questionnaire survey for the key stakeholders to respond regarding the technical inputs for the risk management framework. Objective 1.8.1c was a descriptive question that focused on the dependent variable.

When the response was received the results were compiled and any significant variances were recorded. At this stage, the second round of Delphi was conducted. This was designed based on the responses from the first round. Round two of the Delphi was for the respondents to see the average responses from the other panellists. At this stage, respondents were requested to critically examine the average response given and they had the chance to adjust their answers from the first round or maintain the given response. Finally, the third round was evoked for the final confirmation of their responses after the adjustment was done in Round two. The three-round Delphi procedures have been supported by various researchers (Ameyaw et al., 2016; Keeney et al. 2011).

There was a high degree of confidentiality of the respondent's identity among themselves (though not to the researcher and the researcher supervisors) throughout the process (Okoli & Pawlowski, 2004). This is done to enhance the satisfactory degree of consensus. Furthermore, the technical justification for the use of the Delphi technique (Beech 1999), is that it allows free expression of expert views and also allows the combination of many opinions into a collective response. Expert selection done in consultation with the research supervisors was based on the well-used criteria as follows;

a.) Having extensive working experience and experts (more than 5years) on PPP construction projects either as a Project Manager, Consultant, Government Officials, Academician, Project Sponsor, or any other relevant position.
b.) Experts involved in the financing of mega construction projects and transaction advising.
c.) Experts directly involved in the managing of HPP/PPP projects in a developed or developing nation and have gained in-depth knowledge of the PPP models.

The third objective involved the development of a Risk Management Framework (RMF) that could be appropriate to apply in the PPP Hydro Power projects.

5.4 Philosophy of the Study

Philosophy is referred to as the process by which principles or beliefs are coordinated including the growth of knowledge and making use of the acquired knowledge (Bal,2014; Saunders,2016; Crossan, 2003, p.47-48). The author continues that knowledge development encompasses solving the identified research in various sectors of life. The knowledge that is intended to be generated is influenced by philosophical assumptions (Awodele, 2012). Thus, it is inevitable to establish how claims about knowledge are generated or the nature of reality. This component in philosophy is referred to as ontology (Hartley, 2008; Mccann & Busadm, 2014; Subedi, 2016). While the epistemology component goes further to understand acknowledgement of the real truth or relationship between the researcher and the subject matter (Linstone & Turoff, 2002; Arimah, 2017; Awodele, 2012; Toledo-Pereyra, 2012; Lengwe, 2014), what value goes into it the research is identified as axiology (Subedi, 2016; Awodele, 2012; Kurniawan, 2013), how it is written about or what is the language of the research is referred to as rhetoric (Boardman, Poschmann, & Vining, 2005; Awodele, 2012; Mcquaid, 2010), and the processes for studying is known as a methodology (Marco & Thaheem, 2014; Parker, Dressel, Chevers, & Zeppetella, 2018; Berezin, Sergi, & Gorodnova, 2018).

Saunders et. al. (2007) states that ontology and epistemology philosophical components aids in the selection of the research methodology, and also enables the researcher to systematically come up with the technique to outline the research objectives. Besides, Merriman (1998) and Creswell (2003) contribute that the initial aspect of the research should encompass deep scrutinizing of the ontological and epistemological perspectives on reality, research purpose, and knowledge type needed. This is in agreement with Saunders, Lewis & Thornhill (2012), whose assertion was that the selection of the model should depend on how researchers view and interpret the reality of the world and the acknowledgement of it as real truth. Thus, in undertaking this research, this author embraced the nature of the research questions, objectives of the study, theories and the variables (independent, moderating, mediating and dependent variable) as the main determinants of the research philosophy. With a deep comprehension of the research objectives, this author applied an exploratory sequential mixed-method design. The philosophical underpinning of this method was that the researcher needed to be pragmatic to answer all three objectives. The operationalization of epistemology and ontology in this research has been elaborated in sections 5.4.1 and 5.4.2.

5.4.1 Epistemology

Epistemology refers to the ways of comprehending and giving an explanation about how researchers know what their claims of knowledge are (Toledo-Pereyra, 2012; Crotty, 2003). It provides a philosophical underpinning in making decisions about types of knowledge that are possible and measurement for the same inadequacy and legitimacy (Maynard, 1994). While Aliyu (2017), contributes that it looks at the certainty in understanding what can be known and that which can be regarded as acceptable know-how in a particular area. The two epistemological methods commonly associated with the Delphi method, the technique being employed by this research design are social constructivism and positivism (Fink-Hafner, Dagen, Doušak, Novak, & Hafner-Fink, 2019; Berman, 2018). Positivists (quantitative) believe that knowledge is absolute and universal that can be measured with experiments while Constructivists (qualitative) believe that knowledge is not fixed on certain beliefs but can be explored (Berman, 2018; Awodele, 2012; Kurniawan, 2013; Mccann & Busadm, 2014). Subedi (2016) further explains that the application of the epistemological approach in a pragmatic manner, there is an embracement of both objective and subjective perspectives in the tackling of the research objectives in mixed-method research. Positivism and social constructivism are in tandem with this research guided by the research objectives which were tackled with the Delphi method (qualitative/constructivism) and whereas, from the positivism side this research conducted mean score analysis (Seow et al., 2014), Cronbach's alpha reliability test (Olawumi & Chan, 2018), Standard Deviation (Osei-Kyei et al., 2017), factor analysis for risk management and hypothesis testing using chi-square (Hillson & Hulett, 2004; Dunn, 2017) from SPSS version 16.0. Justification of the application of the statistical tools has been given in section 4.7. To realize the risk management framework for HPP/PPP, there is a need to ensure that precise methods are embraced and that the data used should be valid through positivism and constructivism.

5.4.2 Ontology

This component of research is concerned with nature and social reality, while it raises questions about the perceptions and assumptions researchers to have over the same (Bracken 2014). Researchers have further classified Ontology into four attitudes which are; nominalism, relativism, realism, and internal realism (Lengwe, 2014; Aliyu, 2017; Awodele, 2012). This research adopts a position of realism approach (Chung & Rose, 2008; Kurniawan, 2013; The World Bank, 2013) as it is compatible with pragmatic philosophies in delivering extra insights and alternative viewpoints in research. There is scientific proof that this approach is impartial and stands independent of human opinions and known beliefs (Kurniawan, 2013; Chung & Rose, 2009; Linstone & Turoff, 2002). World Bank (2013) proved that quality and realism in project preparation must be high to ensure success in public-private partnerships and deliver sustainable and lasting development outcomes. Thus, in this HPP/PPP risk framework development, this author strives to integrate the realism approach critical analysis of both qualitative and quantitative data obtained.

5.5 Study Population

The study respondents consisted of PPP Experts/Practitioners from both academia and industry, Project Managers, Contractors, Consultants, and Government officials at the Ministry of Finance (PPP department), ZESCO limited representatives, Ministry of Housing and Infrastructure Development, and Ministry of Energy.

5.5.1 Sample Survey and Sampling Techniques

As this is mixed-method research, the sample population was compiled in three ways. For the first two objectives (1.8.1a and 1.8.1b) of the study, a Delphi technique was used. According to previous research done and in particular PPP construction projects, the total number of the panel of experts(academics and practitioners) that forms the Delphi technique is 15-20 (Okoli & Pawlowski, 2004; Ernest E. Ameyaw et al., 2014; Carbonara, Costantino, Gunnigan, & Pellegrino, 2015; Linstone 1978; Cavalli-Sforza & Ortolano 1984; Ludwig,1997). This study had registered 22 panels of experts. The number of a suggested panel of experts as per previous researches is commonly based on resource availability and the expertise of panellists (Nunzia Carbonara & Pellegrino, n.d; Armstrong,1985). However, Delbecq et al., (1975) and Nunzia Carbonara & Pellegrino (2018) argued that distinctively the large sample size is suitable for the generation of data and builds confidence in the data analysis undertaken. Though, Nunzia Carbonara & Pellegrino (2018), in contradiction stated that this might lead to problematic issues with regards to data handling and potential analysis complications.

Due to the desired high credibility of the study, the compulsory in-depth knowledge, and sound experience about HPP/PPP construction projects, a purposive sampling technique was adopted for a panel of experts' selection (Taherdoost, 2018; Edmunds 1999; Ke et al. 2010). In this technique, only known experts with proven records are deliberately selected to be part of the study. PPP is still not a common procurement model being used in Zambia compared to other countries like Germany, United States, Brazil, Canada, Singapore, Spain, Hong Kong, Australia, South Korea, Japan, France, Iran, and China (Adetola et al., 2011; Brook; 2001; Chan et al., 2009; Daube, Vollrath, & Alfen, 2008; Deloitte, 2006; Hamilton, 2001; Kouvarakis, 2001; Noorzai, Jafari, Golabchi, & Hamedi, 2016; The PFI Report, 2001). Hence, the critical and valid information is more prominently found with the experts associated with this procurement model and academic researchers. Though there developing countries such as India, Nigeria, Cameroun("Demystifying Issues Regarding Public-Private Partnerships (PPP)," 2016) have advanced in the use of the PPP procurement model making it easier for researchers to get some experts with hands-on experience in the specialized subject.

The third and last objective (1.8.1c) was responded to by the questionnaire survey used to collect the data needed from a broad spectrum of key stakeholders in HPP/PPP projects. The population sample was composed of five strata; Consulting Engineers and Transaction Advisors, Project Financing Institution, Regulators, Sponsors, Construction Contractors working on mega construction projects in Zambia and outside but with experience on PPP projects, Ministry of Finance Officials & PPP Departments and PPP Advisory Consultants. Since, this author did not find any database of PPP participants in infrastructure projects and particular hydropower projects dictated the use of non-random sampling techniques also known as non-probability sampling in the coming up with the strata (Showkat & Parveen, 2017). Showkat & Parveen (2017) clarifies this technique is mostly used in studying prevailing theoretical insights or developing new ones. As this research strives to develop the risk framework, the subjective selection of the strata for technical inputs was justified.

Taherdoost (2018) supports this author by adding that sample size does not need to be random but is supported with a clear rationale and deep understanding of the subject matter. The individual respondents were identified through purposive expert sampling (Boi & Uwfto, 2012; Personal, Archive, Nsiah-Asare, & Prempeh, 2016; Tolani, 2013), convenience sampling (Taherdoost, 2018), and snowballing sampling (Mccann & Busadm, 2014; Ngoma, Mundia, & Kaliba, 2014) techniques from experts with involvement or insight in PPP construction projects. The 10 participants in each stratum for the questionnaire survey were justified by Ngoma (2015) since there are still limited PPP construction projects being finalized in Zambia.

Thereafter, to supplement the data collected, this author also conducted interviews on each stratum. As of the year 2020, only two hydropower projects were finalized through the PPP procurement model in Zambia. This includes the commissioned Itezhi Tezhi hydropower projects and the Batoka hydropower project signed in the year 2019. Thus, apart from the data obtained through the literature survey, the Delphi technique, questionnaire survey, and interviews complemented any left out critical data. Therefore, the sample survey for the three research designs are summarised in table 5.1(Delphi –Panel of Experts), 5.2(Questionnaire Survey-Technical Experts), and 5.3 (Interviews-Technical Experts):

Table 5. 1: Delphi- Panel of Experts

Category	**Frequency**
Consulting	10
Contracting	2
Government	8
Concessionaire	2
Total	22

Source: Author (2020)

Table 5. 2: Questionnaire Survey-Technical Experts

Characteristics of experts	**Number**
Project Finance	3
Government Official	21
Sponsor	3
Regulator	1
Policy formulation	3
Contractor	10
Consultant	19
Total	**60**

Source: Author (2020)

Table 5. 3: Interviews-Technical Experts *(PPP and Related Experts)*

S/n	Survey Strata	Targeted (Interviews-Qualitative Data)
1	Consulting Engineers	3
2	Project Financing Institution	3
3	Construction Contractors	3
4	Government Officials (Ministry of Finance, Ministry of Housing and Infrastructure Development, and Ministry of Energy)	3
5	PPP Advisory Consultants	3
	Total	**15**

Source: Author (2020)

5.7 Data Collection Tools

A four-phase strategy was applied to collect data with the view of responding to all the research questions. Phase one encompassed carrying out comprehensive literature survey/document reviews on risk management, PPP construction projects, and risk model development. Qualitative data was collected through Content Analysis (Kavishe, 2018; Taran, Boer, & Lindgren, 2013; José Oliveira dos Reis & Cabral, 2017). It has been established that the strength of the extensive literature survey/document reviews lies in the facilitation of validity checks and triangulation. However, Creswell (2014) argues that the weakness of this method is embedded in the cultural differences that typically lead to misinterpretation of data. Furthermore, the data gathered from phase one was used to develop the questionnaire for the Delphi technique (Osei-Kyei et al., 2017; Chaaya, 2018; Okoli & Pawlowski, 2004). This was the second phase as illustrated in sections 5.3.1.1 and 5.3.1.2 to answer objectives 1and 2.

The third phase involved data collection through questionnaire surveys for the technical inputs into the development of the risk management framework, while the fourth stage which was interviews encompassed overall sealing off any left gaps in the data collection process (Ngoma et al., 2014; B. Li, Akintoye, & Hardcastle, 2001; Ke et al., 2011; Tshombe & Molokwane, 2016). The interviews (qualitative design) were suitable for the collection of in-depth responses to in-depth questions. Interview sessions lasted for an average of 30 minutes each. With the permission of the interviewees, the interview sessions were recorded with the aid of the cellphone (telephone interviews) and laptop (Zoom Interviews) which data was subsequently transcribed. The transcripts were then read severally in the bid to establish any patterns worthy of note. Transcripts were thematically analyzed following the pre-set theme selected by the author before the commencement of the interview sessions**.** This comprehensive data collection process is supported by Spector (1981), who praised it that confidence in the findings is heightened.

5.8 Data Analysis

The data collected from four phases (qualitative and quantitative) outlined in section 5.7 were analysed using various statistical methods. The data collected qualitatively was analyzed through the use of the inductive process through building from the data to broad themes and interpretation. The completed questionnaires were edited for completeness and consistency, checked for errors and omissions, and then coded to SPSS and analysed qualitatively and quantitatively. The analysis process has been briefly explained as follows;

5.8.1 Qualitative Analysis- Analytical Hierarchy Framework

To analyse the qualitative data which constituted opinions, perceptions, and facts as elaborated by respondents during the discussions, the researcher used the Analytical Hierarchy Framework (Fajardo et al., 2016). Fajardo et al., (2016), explains that the analytic hierarchy process (AHP) is widely used in multi-criteria decision-making tool for tackling multi-attribute decision-making problems in real situations (Saaty, 1980). Qureshi et al., (2011) state that it represents a powerful technique for solving complicated and unstructured problems that have connections and correlations among different objectives and goals. Demirel et al., (2012) echo that AHP helps the decision-makers to organize the critical aspects of a problem into a hierarchical structure similar to a family tree. This technique is based on experts' judgments (Saaty, 1980) through pairwise comparisons. This is done by interviewing the experts thereafter a pairwise comparison judgment is applied to pairs of homogenous criteria, eventually generating the overall priorities for ranking the alternatives. The identified risks on HPP/PPP needed to be ranked in order of priority to determine the significance. Hence, this method was very applicable during risk identification.

5.8.2 Quantitative Analysis- Mean Score Analysis

Once the data obtained from the questionnaire survey had been checked, the arrangement was done in a format that enabled easy analysis. Statistical Package for Social Sciences (SPSS 16.0) was used to analyze the data as it offers a more comprehensible interface and can be linked with Microsoft office utility programs. To analyze the quantitative data, descriptive and inferential statistical tools were employed to analyze the responses from the Delphi expert panel, and deductions arrived based on the findings. Descriptive statistics such as mean and risk significance were then generated. Standard deviation represented the degree of variability in the responses. The five-point Likert scale scoring system mentioned earlier formed the basis of calculating the mean score (Chan, 2014; Cheung & Chan, 2011) for each of the risk factors identified. The mean score for each risk factor was used to determine its relative ranking in descending order of importance. The results were then used to determine the risk allocation. These rankings made it possible to triangulate the relative importance of the risk factors. The relative ranking of the factors by all respondents was then determined by comparing the individual mean score and the standard deviation for each criterion.

The mean score (MS) for each risk factor was computed by Eq. (4.2)

Calculation of Mean Score

$$MS = \frac{\sum(f \times s)}{N}, (1 \leq MS \leq 5)$$

Equation 5.1; Source (Yehoue et al., 2010)

Where

S - Score given to each risk factor by the respondents, ranging from 1 to 5 (1 = Least Important and 5= Most Important);

f- Frequency of each rating (1–5) for each risk factor; and

N -total number of responses concerning a particular risk factor

Further, the Project risk which a joint function of the probability of occurrence and severity and was be measured with the following formula(Chan, 2014):

Project Risk

$$Risk = f\left(probability, severity\right)$$

Equation 5.2; Source (Chan, 2014)

Shrestha (2015) supports this method as it has been used by several researchers in the area of construction and risks while analysing questionnaire data from a Likert scale to establish the relative importance of factors under investigation. Chan and Kumaraswamy (1996) adopted this technique to rank the causes of delays in building construction projects in Hong Kong. Furthermore, Xu et al. (2010) used the same technique to weigh critical risks in their research to develop a fuzzy risk assessment model. Hence, this technique is suitable for this research as the main objective is to develop the model.

5.8.3 Multiple Regression Analysis – Technical Inputs & Research Variables

Multiple regression analysis was employed in this study to statistically relate the behaviour or variation of two or more independent variables to determine their unit or collective influence on a dependent variable as indicated by Multiple regression coefficient-R (Shyti & Valera, 2018). Zsuzsanna & Marian, (2012) echoed the aforementioned method when analysing performance indicators in the ceramic industry as it was observed that the dependent variable (project size) was found to be significantly relating to only three independent variables out of the following variables: self-financing capacity, return on equity, degree of technical endowment, personnel cost per employee and investment per person employed after monitoring them for ten years.

To determine the relationship between independent and dependent variables, multiple regression Coefficient-R was calculated using regression mode, with the help of SPSS application and outputs derived, whereas shown in the model summary tables in chapter six. Thereafter, multiple regression analysis was used in determining the Adjusted R-Square value showing accuracy in the percentage of the level of variations in the dependent variable that could be attributed to the independent variables leaving the balance to be explained by other factors, not within the confines of this study. The method enabled this researcher to compute the behaviour of the dependent variable about the unit adjustments on the independent variables. The analysis was composed of the model summary table which provided the aforementioned parameters that were used to decide on how well a regression model fits the data.

Furthermore, analysis went on identifying which of the independent variables statistically significantly relate to the dependent variable coupled with their respective levels of contribution. Study hypotheses were formulated based on the existence of a significant relationship between independent and dependent variables. To understand the levels of significance of existing relationships, p-values were computed where it was observed that in an instance where p-values ($P<0.05$) the hypothesis was accepted whereas if ($P>0.05$), reject the hypothesis. The Multiple regression model was thus formulated as follows:

$$\mathbf{y = \alpha + b_1 x_i + b_2 x_2 + b_3 x_3 + \ldots\ldots\ldots\ldots\ldots\ldots b_n x_n + \varepsilon}$$

y= dependent Variable,

α = regression coefficient (constant),

b_1, b2, b3…,,,,,,,., b_n=slopes,

x_i, x_2, x_3…………x_n=Independent variables and

ε=error term.

Equation 5.3; Source: Zsuzsanna & Marian, (2012)

5.9 Pilot Study

The importance of the pilot study was to ensure that all the suggested research instruments were measuring their intended purpose for the assurance of validity. Once the items (Questions) of the questionnaire were appraised, a pilot study was done on the Lusaka Province in the Ministry of Works & Supply and some experts in HPP/PPP. The pilot study was done with 15 respondents to validate the questionnaire (Polit et al., 2001; Teijlingen et al. 2001). The selection of the respondents for the pilot study was done using simple random sampling. Apart from validating the questionnaire, the pilot experience helped in assessing the feasibility of a (full-scale) study (Polit et al., 2001; Teijlingen et al. 2001). The pilot helped in determining that the research project was realistic and workable as it uncovered potential logistical problems that most pilot tests tend to show (Teijlingen et al. 2001). The researcher had an opportunity to perfect the questionnaire to determine whether or not the items (questions) are inappropriate or too complicated (De Vaus, 2014; Baker 1994). During the pilot study, the researcher was in a position to eliminate or refine or re-order the questions/items (Teijlingen et al. 2015). The pilot exercise also allowed the possibility to test the recording process as well as the transcription.

5.9.1 Summary of the Pilot Study

The preliminary conclusions from the research questions were that identification of the risks and effective analysis is very imperative before the allocation is done. Also, the notion that most risks must be allocated to the private party on the PPP projects was rejected by the respondents who preferred more risks to be shared or allocated to the party with wealth and capacity to manage them. It was established that the more risks accepted by the private party the higher the transaction costs. Among the technical inputs to the risk framework, only some of them showed high significance compared to other inputs.

5.10 Reliability

For the questionnaires, the researcher conducted a reliability test before distribution to the study respondents. The reliability of the five-point Likert scale used in the survey questionnaire was tested for internal consistency using the Cronbach's coefficient, (Osei-Kyei et al., 2017; Ngoma et al., 2014). Li & Stacks (2016), explains the reliability of the measuring instruments is usually assessed with the use of the Cronbach Alpha Coefficient. A reliability of 0.60 and 0.70 or above are considered to be the criteria for demonstrating the internal consistency of new scales and established scales respectively (Li & Stacks, 2016).

Furthermore, the credibility/trustworthiness (Reid, 2000) to ensure that the established results are accepted and believed was enhanced through the use of laborious techniques. Also, it involved the collection of high-quality data that was judiciously analyzed, concerning validity, reliability, and triangulation. This author spent a lot of time understanding the theoretical and philosophical underpinning of risk management on hydropower projects finalized through Public-Private Partnership.

5.11 Validity

Validity plays a pivotal role in determining the accuracy of the findings from the researcher, respondents, and examiners (Epstein, 2006; Edition, n.d.). How well the research covers the area of concerns and how effective the techniques applied measured the intended objectives are referred to as validating (Linstone & Turoff, 2002; Taherdoost,2016; Zheng, Yuan, Guo, Skibniewski, & Zhao, 2018). For this research, the following was applied in achieving validity;

(i) Data collection tools were anonymous and tested for comprehensiveness and logic by carrying out a pilot test with potential respondents. There was a note to ask the respondents to make comments on the structure, coverage, originality, and significance of the questions. Thereafter, amendments were made to the questionnaires before final administering to the intended respondents.

(ii) The research collected data from literature survey (secondary), Delphi Technique, questionnaires, and interviews (primary) involving a different amount of sample sizes, this enabled triangulation of the results covering all the missing gaps.

All in all, the three customary validity types were incorporated into this study. These included Criterion Validity that looked at the extent to which the research instrument relates to other instruments measuring similar variables. Content validity (Wet, 2016), was the second type that was part of the study to ensure that the instruments accurately measured all aspects of a paradigm. This also looked at how representative and comprehensive the variable items were in presenting the hypothesis (Sarvari et al., 2019). Finally, Construct validity (Okoli & Pawlowski, 2004) was applied which relied on a pure description of the construct. This was very applicable to this study as during the Delphi study designs, the participants were requested to validate their initial responses to ensure that they understand the in-depth- meanings of the independent, moderating, mediating, and dependent variables.

5.12 Ethical Considerations.

This author had an obligation to respect the rights, values, needs, desires, and beliefs of the various potential key stakeholders in this research. The philosophy which was anchored on ethical consideration was the axiological assumption. This refers to the values and ethical issues that must be put into consideration during research planning (Toledo-Pereyra, 2012). It was imperative to define and appraise right and wrong behaviour relating to the research participants. And mostly, these were organizations and individuals who participated in this study. Thus, the questionnaires and interview templates were designed and verified to ensure there is no element of concerns that affect the participants. The author developed a preamble that was sent to the potential respondents explaining their anonymity, confidentiality, and confirmation that any data collected was purely for academic purposes (Andrade & Loiola, 2013).

As PPP involves both the public and private parties, this author paid utmost attention to the handling of confidential information that came across during the research. Some documents included commercial agreements, risk registers, regulatory directives which were not ready for the public domain. Also, the researcher paid attention to the appropriate treatment of confidential information. Three ethical rules of research were stringently observed. The research was based on the principle of truth and reliability known as veracity (Reid, 2000; Ford, 2007)**.** Privacy was the second ethical issue that was based on the promotion of adhering to unanimity (Dunn, 2017). It enhanced participants to freely and comfortably respond openly to the study discussion. It was agreed that all information and material obtained was for academic purposes only. Finally, fidelity (Linstone & Turoff, 2002; Banda, 2019) dealt with keeping the promises and avoiding carelessness with obtained information or material.

5.13 Chapter Summary

This chapter discussed several philosophical assumptions from the research approach, research design, data collection, analysis, reliability, and validity. Pragmatism was the worldview underpinning the entire study. Thus, a sequential exploratory mixed method was adopted and used. Rules were adhered to in the coming up with the sample and sampling procedures. All the technical and research instruments used in this study was related to a mixed-method research approach. The issue of validity and reliability being imperative was included in this research. To ensure the study was in line with the academic requirements, ethical considerations were highly explored. The next chapter which is five presents the data findings.

CHAPTER SIX

DATA PRESENTATIONS AND FINDINGS

6.1 Introduction

This chapter presents the findings of the study. It includes the identification of various risks associated with public-private partnership pre-concessions for hydropower projects during the development stage and how such risks are allocated among project partners. The study further explores the risks by assessing their likelihood of occurrence and effects on the development of hydropower projects. Finally, the chapter presents the techniques for developing a risk management framework suitable for Zambia Hydropower Projects implemented through Public-Private Partnerships; and tests the framework's dependent variables and outcomes to determine the reliability of the framework.

To realize the findings of the study, the research methodology encapsulated in chapter four was followed. Two separate research questionnaires were distributed to judiciously selected experts who had previous industrial and academic experience on the development processes of public-private partnership pre-concessions for hydropower projects. An in-depth interview was also structured and targeted for similar 15 experts but due to the COVID 19 pandemic, only 8 managed to participate through Zoom and Cell phone platforms. The first questionnaire, which was designed to address the first and second research objectives was administered to 20 respondents based on a three-round Delphi technique. The second questionnaire was administered to a group of 60 respondents with the view to address the third research objective of identifying the technical inputs for developing the framework. An initial response rate of 100% was achieved on both questionnaires due to persistent communication and the allocation of sufficient time allowance for responses to be made. However, after the first round, the response rate was reduced by a smaller percentage. The research data was entered into SPSS and Microsoft Excel for analysis.

6.2 Reliability Test Results

To determine the internal variance reliability of the responses, the researcher conducted a reliability test called the Cronbach test. The decision criteria in the use of the Cronbach's test hinges on the greatness of the Cronbach's alpha above 0.7 (or 70%).

6.2.1 First Questionnaire – Delphi Technique

For this study, Cronbach's alpha value of 0.946 (94.6%) was obtained based on 41 items. This means that the estimated internal reliability associated with the results that can be derived from a composite score or scale is 94.6%. Table 6.1 shows the Cronbach test value derived using the statistical package for social sciences (SPSS):

Table 6. 1: Cronbach Test

Case Processing Summary		N	%
Cases	Valid	17	77.3
	Excluded(a)	5	22.7
	Total	22	100.0

Source: Author (2020)

Reliability Statistics

Cronbach's Alpha	N of Items
.946	41

Source: Author (2020)

6.2.2 Second Questionnaire

For this study, Cronbach's alpha value of 0.958 (95.8%) was obtained based on 55 items. This means that the estimated internal reliability associated with the results that can be derived from a composite score or scale is 95.8%. Table 6.2 shows the Cronbach test value derived using the statistical package for social sciences (SPSS):

Table 6.2: Cronbach Test

Case Processing Summary		N	%
Cases	Valid	59	98.3
	Excluded(a)	1	1.7
	Total	60	100.0

Source: Author (2020)

Reliability Statistics

Cronbach's Alpha	N of Items
.958	55

Source: Author (2020)

6.3 Identification and Ranking of Risks at Project Development Stage

6.3.1 Characteristics of Respondents

The first survey questionnaire incorporated certain demographic questions about the experts such as the type of organizations they were associated with, organizational designations as well as the highest level of academic achievement to help provide important insight into the relevant background information of the respondents. Characteristics of the respondents were analyzed using descriptive statistics generated from the statistical package for social sciences (SPSS), which are presented in this subsection using frequency distribution tables.

Table 6.3 shows the frequency distribution of various types of establishments with which the respondents were associated. The Delphi Technique was the tool used to collect this data.

Table 6. 3:Type of Establishment

	Type of Establishment	Frequency	Per cent	Valid Percent	Cumulative Percent
Valid	Consulting	10	45.5	45.5	45.5
	Contracting	2	9.1	9.1	54.5
	Government	8	36.4	36.4	90.9
	Concessionaire	2	9.1	9.1	100.0
	Total	22	100.0	100.0	

The survey revealed that 45.5% of the respondents were associated with consulting firms, 9.1% were associated with contracting firms, 36.4% were associated with the government establishment and 9.1% were associated with concessionaire establishments. Therefore, the majority of the respondents were seen to be associated with the consulting (45.5%) and government (36.4%) establishments respectively. There were only 9.0% of the respondents who belonged to other types of establishments namely quasi-government (4.5%) and training and consultancy (4.5%) as shown in table 6.4 :

Table 6. 4: Other Type of Establishment

Other Type of Establishment		Frequency	Per cent	Valid Percent	Cumulative Percent
Valid		20	90.9	90.9	90.9
	Quasi Government	1	4.5	4.5	95.5
	Training and Consultancy Centre	1	4.5	4.5	100.0
	Total	22	100.0	100.0	

Concerning determining the organizational designations of the respondents, the survey showed that consultants constituted the clear majority of the experts, accounting for almost 45.5% of the respondents; followed by project managers and contractors, who constituted 18.2% each of the experts. The directors and SHEQ managers/engineers constituted 9.1% of each of the experts who responded to the questionnaire as shown in table 6.5 below:

Table 6. 5: Designation of Respondents

		Frequency	Per cent	Valid Percent	Cumulative Percent
Valid	Director	2	9.1	9.1	9.1
	Project Manager	4	18.2	18.2	27.3
	Contractor	4	18.2	18.2	45.5
	SHEQ Manager/Engineer	2	9.1	9.1	54.5
	Consultant	10	45.5	45.5	100.0
	Total	22	100.0	100.0	

There were approximately 9.0% of the experts who held other designations namely M&E officer (4.5%) and operations officer (4.5%), as shown in Table 6.6:

Table 6. 6: Other Designations

		Frequency	Per cent	Valid Percent	Cumulative Percent
Valid		20	90.9	90.9	90.9
	M and E Officer	1	4.5	4.5	95.5
	Operations officer	1	4.5	4.5	100.0
	Total	22	100.0	100.0	

Source: Author (2020)

The frequency distribution of the highest academic qualifications achieved by the respondents was as shown in table 6.7.

Table 6. 7: Highest Academic Qualification

Highest Academic Qualification		**Frequency**	**Per cent**	**Valid Percent**	**Cumulative Percent**
Valid	BA	2	9.1	9.5	9.5
	BSc	2	9.1	9.5	19.0
	MA	1	4.5	4.8	23.8
	BEng	3	13.6	14.3	38.1
	MSc	9	40.9	42.9	81.0
	MEng	3	13.6	14.3	95.2
	PhD	1	4.5	4.8	100.0
	Total	21	95.5	100.0	
Missing	System	1	4.5		
Total		22	100.0		

Source: Author (2020)

The survey showed 38.1% of the respondents held undergraduate degrees either as BA (9.5%), BSc (9.5%), MA (4.8%) or B.Eng. (14.3%) as their highest academic qualification. However, a vast majority of the respondents of approximately 57% were holders of master degrees in either

MEng (14.3%) or MSc (42.9%). There was ostensibly only one respondent among the experts (4.8%) who held a doctorate as the highest academic qualification.

6.3.2 Risk Identification and Allocation

To effectively explore the various risks associated with hydropower projects a total of forty-two risk indicators were identified in the questionnaire that was presented to project experts. These forty-two risk indicators, for analysis, were clustered into seven broad risk categories namely contractual risks, financial risks, economic risks, political risks, social/environmental risks, regulatory/legal risks, and technical risks. The respondents attributed the risk indicators to the project development stages (feasibility stage, planning stage, and procurement stage) and further allocated them to project partners (private entity, public entity, or equal sharing) based on their knowledge. It is the concentration of this subsection to present an analysis of risk identification and allocation in hydro-power projects. This is critical in the conceptual framework as the identified risks must be allocated with the party with the capacity to manage them.

6.3.2.1Technical Risks

The survey showed that technical risks were highest during the planning stage accounting for 56.8% in comparison with 30.8% in the feasibility stage and 12.4% in the procurement stage respectively. Risks relating to unproven engineering techniques and incompetent project teams were the most significant risks faced during the planning stage with each one accounting for 10.7% of the risks. On the other hand, incompetent project team members were the most encountered individual risk in all the project development stages accounting for 19.5% of all technical risks.

a.) Risk Identification

Table 6.8 shows the distribution of technical risks in the development stages of public-private partnership pre-concessions for hydropower projects:

Table 6. 8: Technical Risks at Project Development Stages

	Project Development Stage			
Technical Risks	**Feasibility**	**Planning**	**Procurement**	**Total**
Pre-constructional activities	3.6%	4.7%	2.4%	10.7%
Inadequate design details	1.2%	10.1%	1.2%	12.4%
Inadequacy of water (Hydrology)	2.4%	9.5%	1.8%	13.6%
Incompetent project team members	5.9%	10.7%	3.0%	19.5%
Lack of feasibility study	8.3%	6.5%	0.6%	15.4%
Residual value (after the concession period)	6.5%	4.7%	3.0%	14.2%
Unproven engineering techniques	3.0%	10.7%	0.6%	14.2%
Total	**30.8%**	**56.8%**	**12.4%**	**100.0%**

Source: Author (2020)

Table 6.9 shows the allocation of technical risks between the entities involved in the development of public-private partnership pre-concessions for hydropower projects:

b.) Risk Allocation

The survey revealed that private entities had a higher allocation of technical risks (46.6%) than public entities (13.5%). On the other hand, the proportion of the equally shared risk (39.9%) is almost as high as that allocated to the private entities. Allocation of specific risks indicated that incompetent project and residual value (after concession period) risks were the highest-ranked risks accounting for 15.3% each. Risk of Pre-Construction Activities was the highest risk attributed to private entities (13%) including the risk of unproven engineering techniques (10.2%). While the public sector had risk residual value (after concessions) as the most dominant technical risk factor. Table 6.9 shows the risk allocation.

Table 6. 9: Allocation of Technical Risks between Project Partners

	Project Risk Allocation			
Technical Risk	**Private Entity**	**Public Entity**	**Equally Shared**	**Total**
Pre-constructional activities	13.0%	0.1%	1.5%	14.6%
Inadequate design details	7.3%	0.7%	5.1%	13.1%
Inadequacy of water (Hydrology)	4.4%	0.7%	9.5%	14.6%
Incompetent project team	8.8%	0.9%	5.8%	15.3%
Lack of Proper feasibility study	5.0%	1.5%	6.6%	13.1%
Residual value (after the concession period)	1.9%	9.6%	3.8%	15.3%
Unproven engineering techniques	10.2%	1.0%	2.6%	13.9%
Total	**50.6%**	**14.5%**	**34.9%**	**100.0%**

Source: Field Data (2020)

6.3.2.2 Contractual Risks

It was revealed from the survey that in the development process of Hydro-power projects, the largest proportion of contractual risks came to the fore during the planning stage while the risk was lowest in the feasibility stage. Almost 38% of all contractual risks occurred in the planning stage, 35.1% occurred during the procurement stage and 27% occurred in the feasibility stage. Risks emanating from faults in the tender specification (22%) were the most common contractual risks faced in all the project development stages, followed by accountability/transparency risks (14.1%).

a.) Risk Identification

Table 6.10 shows the distribution of contractual risks at the development stages of public-private partnership pre-concessions for hydropower projects:

Table 6. 10: Contractual Risks at Project Development Stages

	Project Development Stage			
Contractual Risks	**Feasibility**	**Planning**	**Procurement**	**Total**
Accountability/Transparency	2.6%	6.3%	5.2%	14.1%
Changing needs	3.1%	7.3%	3.1%	13.6%
Counter party's creditworthiness.	7.3%	3.1%	1.6%	12.0%
Different working methods/know-how between partners.	3.1%	8.4%	2.1%	13.6%
Fault in tender specification	7.3%	5.2%	9.4%	22.0%
Inadequate tendering	0.0%	1.6%	9.9%	11.5%
The conflict between partners.	3.7%	5.8%	3.7%	13.1%
Total	**27.2%**	**37.7%**	**35.1%**	**100.0%**

Source: Field Data (2020)

b.) Risk Allocation

The study showed that most of the contractual risks were equally shared between public and private entities. However, the public entities had a higher individual allocation compared with private entities. 54.0% of contractual risks were equally shared, 24.8% were allocated to public entities and 21.2% were taken up by private entities. The conflict between partners along with different working methods (know-how between partners) was seen to be the most equally shared contractual risk in Hydro-power public-private partnership projects.

Table 6.11 shows how contractual risks were allocated between the entities involved in the development of public-private partnership pre-concessions for hydropower projects:

Table 6. 11: Allocation of Contractual Risks between Project Partners

Contractual Risks	Risk Allocation Private Entity	Public Entity	Equally Shared	Total
Accountability/Transparency	3.6%	3.6%	8.0%	15.3%
Changing needs	2.9%	3.6%	7.3%	13.9%
Counter party's creditworthiness.	3.6%	3.6%	7.3%	14.6%
Different working methods/know-how between partners.	0.7%	3.6%	10.2%	14.6%
Fault in tender specification	3.6%	8.8%	1.5%	13.9%
Inadequate tendering	6.6%	0.7%	5.8%	13.1%
The conflict between partners.	0.0%	0.7%	13.9%	14.6%
Total	**21.2%**	**24.8%**	**54.0%**	**100.0%**

Source: Field Data (2020)

6.3.2.3 Financial Risks

Financial risks facing HPP/PPP were ostensibly the highest in the planning stage of project development accounting for 43.5% of all financial risks in comparison with 30.0% incurred in the feasibility stage and 26.5% incurred in the procurement stage respectively. Conversely, the risk of low liquidity was the single largest risk accounting for 29.9%.

a.) Risk Identification

Table 6.12 below shows the distribution of financial risks during the development stages of public-private partnership pre-concessions for hydropower projects:

Table 6. 12: Financial Risks at Project Development Stages

	Project Development Stage			
Financial Risks	**Feasibility**	**Planning**	**Procurement**	**Total**
Cost Estimating/ Cost overruns and schedule delays	7.8%	12.3%	5.8%	25.9%
Financial Constraints/ Funding Approval	12.4%	7.6%	4.9%	24.9%
High Bidding Costs	1.0%	8.0%	10.3%	19.3%
Low Liquidity	8.8%	15.6%	5.5%	29.9%
Total	**30.0%**	**43.5%**	**26.5%**	**100.0%**

Source: Field Data (2020)

b.) Risk Allocation

Private entities had a higher allocation of financial risks in HPP/PPP when compared with public entities. Over 47.9% of the financial risks were allocated to private entities, 37.0% were equally shared and about 19% were allocated to public entities.

Table 6.13 shows how financial risks were allocated between entities involved in public-private partnership pre-concessions for hydropower projects:

Table 6. 13: Allocation of Financial Risks between Project Partners

	Risk Allocation			
Financial Risks	**Private Entity**	**Public Entity**	**Equally Shared**	**Total**
Cost Estimating/ Cost overruns and schedule delays	16.4%	1.4%	6.8%	24.7%
Financial Constraints/ Funding Approval	13.7%	1.4%	12.3%	27.4%
High Bidding Costs	9.6%	8.2%	4.1%	21.9%
Low liquidity	8.2%	4.1%	13.7%	26.0%
Total	**47.9%**	**15.1%**	**37.0%**	**100.0%**

Source: Field Data (2020)

6.3.2.4 Economic Risks

Almost 36.9% of the economic risks associated with HPP/PPP were encountered during the feasibility stage, 33.5% in the planning stage, and 29.6% in the procurement stage. The single most common economic risk was the level of demand for the project which occurred in the feasibility stage and accounted for 13.4% of all the economic risks. On the other hand, the interest rate was the most prominent risk across all the three development stages, accounting for 27.6%.

a.) Risk Identification

Table 6.14 shows the distribution of economic risks in the development stages of public-private partnership pre-concessions for hydropower projects:

Table 6. 14: Economic Risks at Project Development Stages

	Project Development Stage			
Economic Risks	**Feasibility**	**Planning**	**Procurement**	**Total**
Exchange rate fluctuation	5.1%	9.2%	11.2%	**25.5%**
Interest rate.	8.1%	11.2%	8.3%	**27.6%**
Level of demand for the project	13.4%	6.1%	4.0%	**23.5%**
Market competition (uniqueness)	10.3%	7.0%	6.1%	**23.4%**
Total	**36.9%**	**33.5%**	**29.6%**	**100.0%**

Source: Field Data (2020)

b.) Risk Allocation

Public entities had the largest allocation of economic risks amounting to over 37.7% while private entities had a risk allocation of 26%, and 36.4% of the risks were equally shared. Market competition was seemingly the largest individual economic risk facing public entities. On the other hand, fluctuations in the exchange rate were the biggest economic risk facing both public and private entities, accounting for 28.6% of all economic risks.

Table 6.15 shows how economic risks were allocated between entities involved in public-private partnership pre-concessions for hydropower projects:

Table 6. 15: Allocation of Economic Risks between Project Partners

	Risk Allocation			
Economic Risks	**Private Entity**	**Public Entity**	**Equally Shared**	**Total**
Exchange rate fluctuation	7.8%	7.8%	13.0%	**28.6%**
Interest rate.	7.8%	5.2%	11.7%	**24.7%**
Level of demand for the project	7.8%	7.8%	6.5%	**22.1%**
Market competition (uniqueness)	2.6%	16.9%	5.2%	**24.7%**
Total	**26.0%**	**37.7%**	**36.4%**	**100.0%**

Source: Field Data (2020)

6.3.2.5 Political Risks

The largest proportion of political risks were encountered during the procurement stage with the risks being substantially lower during the planning stage. Approximately 38.1% of political risks were faced during the procurement stage in comparison with 37% and 34.9% faced during the feasibility and planning stage respectively. Administration red tape to affect project timeline (10.5%) was the most common risk faced during the procurement stage while the Public opposition to projects (12%) was seen as the most common risk faced during the feasibility stage. Political interference, which accounted for 24.4% was the largest overall risk faced in the development stages of Hydro Power Projects.

a.) Risk Identification

Table 6.16 shows the distribution of political risks in the development stages of public-private partnership pre-concessions for hydropower projects:

Table 6. 16: Political Risks at Project Development Stages

	Project Development stage			
Political Risks	**Feasibility**	**Planning**	**Procurement**	**Total**
Administration red tape to affect project timelines.	6.1%	3.8%	10.5%	20.4%
Expropriation or Nationalization of assets	4.7%	6.2%	8.2%	19.1%
Political Interference	7.4%	6.6%	10.4%	24.4%
Public opposition to projects	12.0%	1.7%	5.5%	19.2%
The poor public decision-making process	6.8%	6.6%	3.5%	16.9%
Total	**37.0%**	**24.9%**	**38.1%**	**100.0%**

Source: Field Data (2020)

b.) Risk Allocation

The allocation of political risks to private entities was substantially smaller in contrast to either public entities or equally shared arrangements. 19.1% of political risks were equally shared, 68% were specifically allocated to public entities and only 12.9% were exclusively allotted to private entities. Political interference and the poor public decision-making process which accounted for 15.7% and 17.5.6% respectively were the most common risks associated with public entities. While Administration red tape to affect project timelines was the most predominant risk at 22.6%.Table 6.17 shows how political risks were allocated between entities involved in the development of public-private partnership pre-concessions for hydropower projects:

Table 6. 17: Allocation of Political Risks between Project Partners

Political Risks	Risk Allocation Private Entity	Public Entity	Equally Shared	Total
Administration red tape to affect project timelines.	2.9%	14.9%	4.8%	22.6%
Expropriation or Nationalization of assets	3.0%	10.0%	3.7%	16.7%
Political Interference	2.0%	15.7%	2.9%	20.6%
Public opposition to projects	4.0%	9.9%	5.7%	19.6%
The poor public decision-making process	1.0%	17.5%	2.0%	20.5%
Total	**12.9%**	**68.0%**	**19.1%**	**100.0%**

Source: Field Data (2020)

6.3.2.6 Social/Environmental Risks

Over 52% of risks were encountered in the feasibility stage, 29% in the planning stage, and 18% in the procurement stage. The most common risks associated with each development stage were land acquisition and compensation problems, market dynamics, and corruption which accounted for 11.8%, 7.6%, and 10.4% respectively. Corruption, which accounted for approximately 22.0% of the risks, was the most significant social/environmental risk faced during the development stages of hydro-power projects.

a.) Risk Identification

Table 6.18 shows the distribution of social/environmental risks in the development stages of public-private partnership pre-concessions for hydropower projects:

Table 6. 18: Social /Environmental Risks at Project Development Stages

	Project Development Stage			
Social /Environmental Risks	**Feasibility**	**Planning**	**Procurement**	**Total**
Corruption	6.9%	4.9%	10.4%	22.2%
Cultural differences between main stakeholders	0.0%	4.2%	2.1%	6.3%
Environmental and Forest Clearances.	9.7%	6.9%	2.1%	18.8%
Land acquisition and compensation problems	11.8%	2.8%	2.1%	16.7%
Unforeseen weather/ geotechnical conditions	12.5%	2.8%	2.1%	17.4%
Resettlement and Rehabilitation Issues	11.1%	7.6%	0.0%	18.8%
Total	**52.1%**	**29.2%**	**18.8%**	**100.0%**

Source: Field Data (2020)

b.) Risk Allocation

The survey showed that social/environmental risks were substantially equal shared between project partners, and that risk allocated to individual entities was almost the same. Over 36.5% of the risks were equally shared while 29.7% and 33.8% were exclusively allocated to private and public entities respectively. Cultural differences between main stakeholders, which accounted for 12.9% of all social/environmental risks were seen to be the most significant equally shared risk.

Table 6.19 below shows how social/environmental risks were allocated to entities involved in the development of public-private partnership pre-concessions for hydropower projects:

Table 6. 19: Allocation of Social /Environmental Risks between Project Partners

	Risk Allocation			
Social /Environmental Risks	**Private Entity**	**Public Entity**	**Equally Shared**	**Total**
Social Corruption	4.3%	8.6%	6.9%	19.8%
Cultural differences between main stakeholders	1.7%	1.7%	12.9%	16.3%
Environmental and Forest Clearances.	4.3%	9.5%	2.6%	16.4%
Land acquisition and compensation problems	4.7%	7.8%	3.9%	16.4%
Unforeseen weather/ geotechnical conditions	8.0%	3.6%	5.6%	17.2%
Resettlement and Rehabilitation Issues	6.7%	2.6%	4.6%	13.9%
Total	**29.7%**	**33.8%**	**36.5%**	**100.0%**

Source: Field Data (2020)

6.3.2.7 Regulatory and Legal Risks

Most of the regulatory and legal risks were in the planning stages of project development. Almost 46.7% of the risks were seen to be encountered in the planning stage, 32% in the feasibility stage, and 21.3% in the procurement stage. Legal/Regulatory Framework, as well as Institutional Capacity and delay in issuing project approvals/permits, were the most common risks accounting for 23.8%, 23.1% and 21.7% of all regulatory and legal risks respectively.

a) Risk Identification

Table 6.20 shows the distribution of regulatory and legal risks in the development stages of public-private partnership pre-concessions for hydropower projects:

Table 6. 20: Regulatory And Legal Risks at Project Development Stages

	Project Development Stage			
Regulatory and Legal risks	**Feasibility**	**Planning**	**Procurement**	**Total**
Delay in project approvals and permits	7.0%	11.2%	3.5%	21.7%
Clarity of Law	4.4%	6.9%	3.4%	14.7%
Institutional Capacity,	6.3%	10.5%	6.3%	23.1%
Legal/Regulatory Framework.	9.8%	10.5%	3.5%	23.8%
Legislation change	4.5%	7.6%	4.6%	16.7%
Total	**32.0%**	**46.7%**	**21.3%**	**100.0%**

Source: Field Data (2020)

b.)Risk Allocation

Public entities had a higher regulatory and legal risk allocation compared to private entities: nearly 50.6% of the risks were specifically allocated to public entities, 22.8% to private entities, and 23.6% were equally shared. The survey showed that Legal/Regulatory Framework. And Delay in project approvals and permits were the most common forms of individual project development risks which were allocated to the public entity.

Table 6.21 shows how regulatory and legal risks were allocated between entities involved in public-private partnership pre-concessions for hydropower projects:

Table 6. 21: Allocation Of Regulatory And Legal Risks Between Project Partners

	Risk Allocation			
Regulatory and Legal risks	**Private Entity**	**Public Entity**	**Equally Shared**	**Total**
Delay in project approvals and permits	4.2%	12.4%	4.3%	20.9%
Clarity of the Law	1.0%	10.4%	7.3%	18.7%
Institutional Capacity,	5.2%	5.2%	9.4%	19.8%
Legal/Regulatory Framework.	4.2%	14.3%	3.4%	21.9%
Legislation change	8.2%	8.3%	2.2%	18.7%
Total	**22.8%**	**50.6%**	**23.6%**	**100.0%**

Source: Field Data (2020)

6.4 Benefits of Risk Management

Guided by respondents' own experiences and knowledge, the respondents revealed various benefits associated with the implementation of risk management during project development by indicating the extent of applicability of the provided list of benefits. The questionnaire survey was used to collect this data. The experts were not only drawn from the PPP spectrum but also experts with significant experience in mega construction projects, project financing and academia. The summary of the results is shown in figure 6.1:

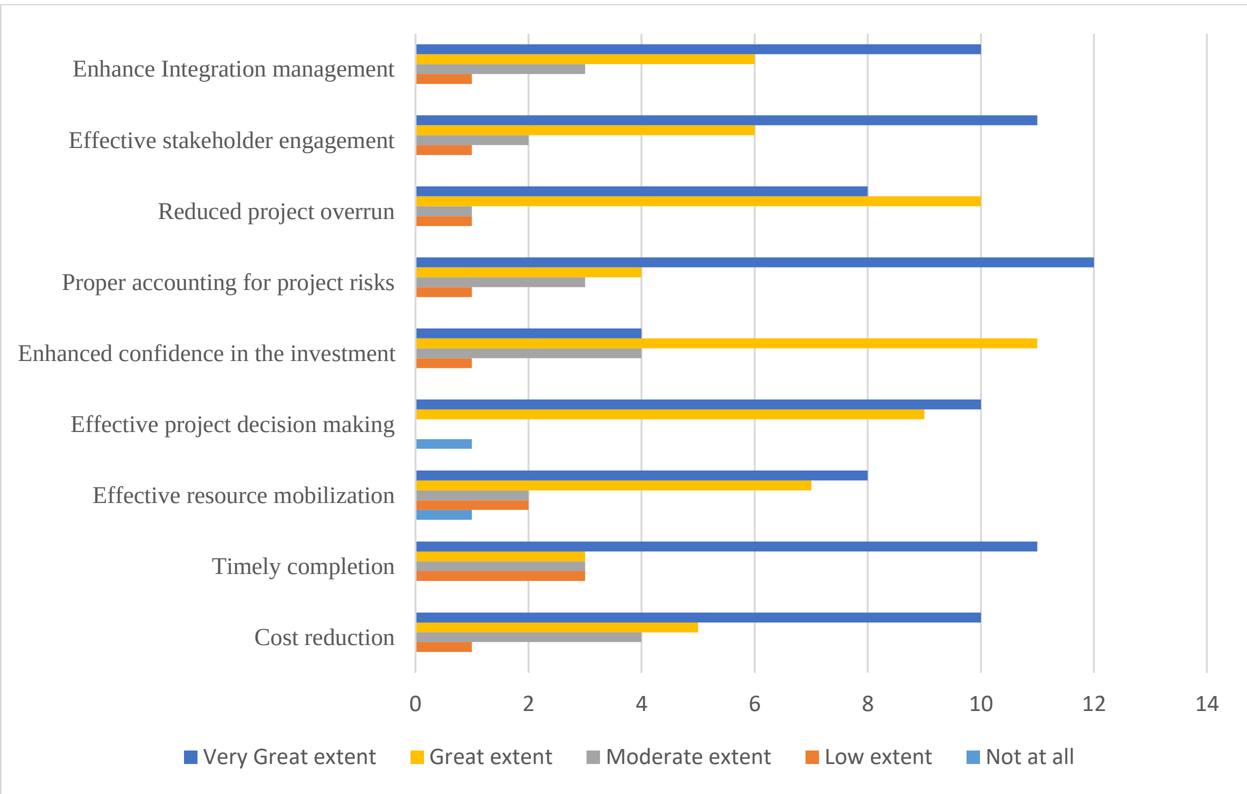

Figure 6. 1: Benefits of Risk Management in Project Development

There was a very high endorsement of the benefits of implementing risk management in the development of hydropower projects. This is shown in figure 6.2.

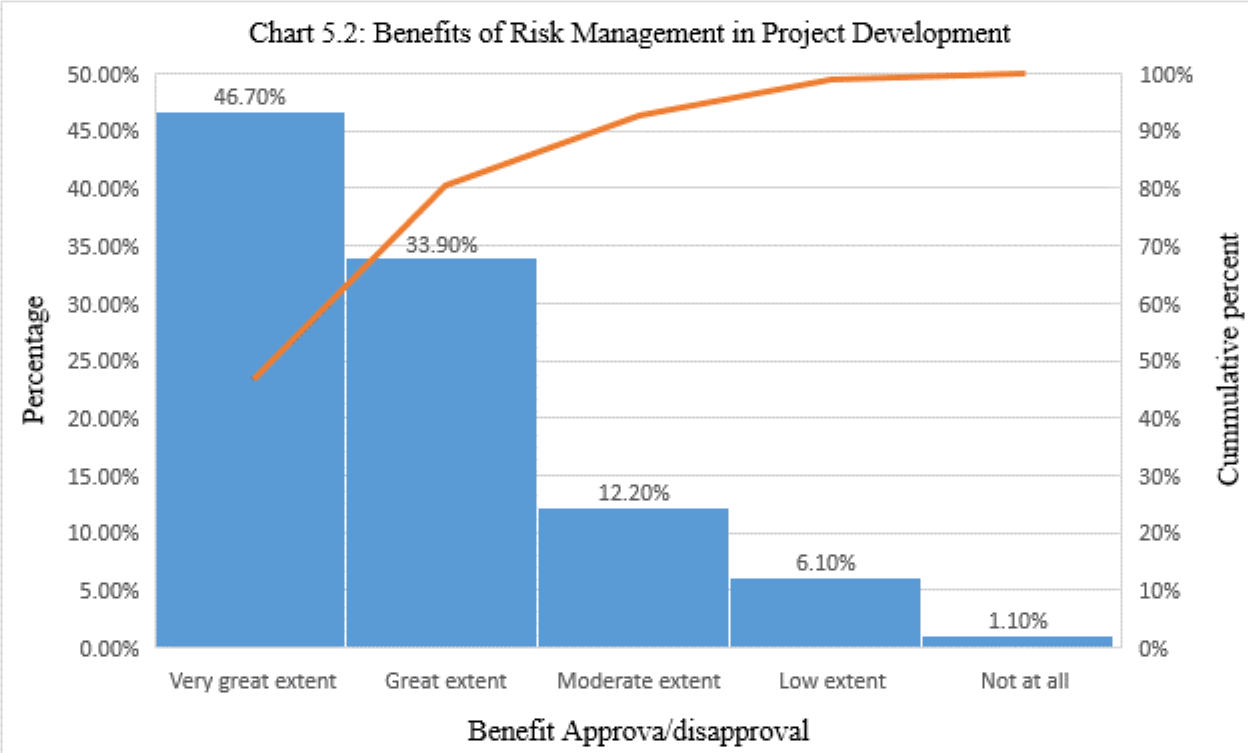

Figure 6. 2: Benefits of Risk Management n Project Development

Nearly 46.7% of respondents affirmed the existence of the benefits as being to a 'very great extent', 33.9% as being to a great extent, 12.2% as being too moderate extent, and 6.1% as being to a low extent. Only 1.1% of the respondents disapproved of the existence of any benefits. Thus the study revealed on a cumulative basis that over 98% of the respondents believed risk management positively benefited the development of hydropower projects, with over 80% of them describing the effect as being great or very great

Further analysis of the 80.6% respondents (i.e. those who affirmed the benefits with 'very great extent' and 'great extent' responses) to establish the stratum of the risk management benefits precipitated in the derivation of table 6.10. The study showed and classified the ranking of risk management benefits. However, three of the most substantial benefits of implementing risk management in the development of hydropower projects were effective decision making (10.6%), reduced project construction delays (10.0%) as well as effective stakeholder engagement (9.4%). In the opposite sense, timely completion (7.8%), cost reduction (8.3%), effective resource mobilization (8.3%), and enhanced confidence in the investment (8.3%) were the least ranked benefits of risk management.

Table 6. 22: Ranked Benefits of Risk Management in Project Development

Risk Management Benefit	Per cent	Rank
Cost reduction	8.3%	5
Timely completion	7.8%	6
Effective resource mobilization	8.3%	5
Effective decision making	10.6%	1
Enhanced confidence in the investment	8.3%	5
Proper accounting for project risks	8.9%	4
Reduced project construction delay	10.0%	2
Effective stakeholder engagement	9.4%	3
Enhanced integration management	8.9%	4
Total	**80.6%**	

Source: Author (2020)

6.5 Risk Probability and Impact

The study examined the identified risks in terms of their likelihood of occurrence alongside the effects in line with the second objective of the research. This subsection analyses the findings which have been presented using charts and tables generated from Microsoft excel. As before, the risks were clustered based on their six categories namely contractual risks, financial risks, economic risks, political risks, social/environmental risks, regulatory/legal risks, and technical risks. Table 6.23 and 6.24 show the Likert scale for the probability of risk occurrence and impacts respectively.

Table 6. 23: Key on Risk Probability

Very likely	likely	somehow likely	slightly likely	Not likely
1	2	3	4	5

Source: Author (2020

Table 6. 24: Key on Risk Impacts

Negligible	Marginal	Substantial	Severe	Disastrous
0 ≤ 20%	21% ≤ 40%	41% ≤ 60	61 ≤ 80	81 ≤ 100

Source: Author (2020)

6.5.1 Contractual Risks – Probability/likelihoods of Occurrence

The study showed that contractual risks were **'likely** to happen (39%). Other probability occurrence chances were rated as follows: slightly likely (26%), somehow likely (26%), very likely (6%), and not likely (3%). Inadequate tendering was the highest contributor to the occurrence of contractual risks. Figure 6.2a

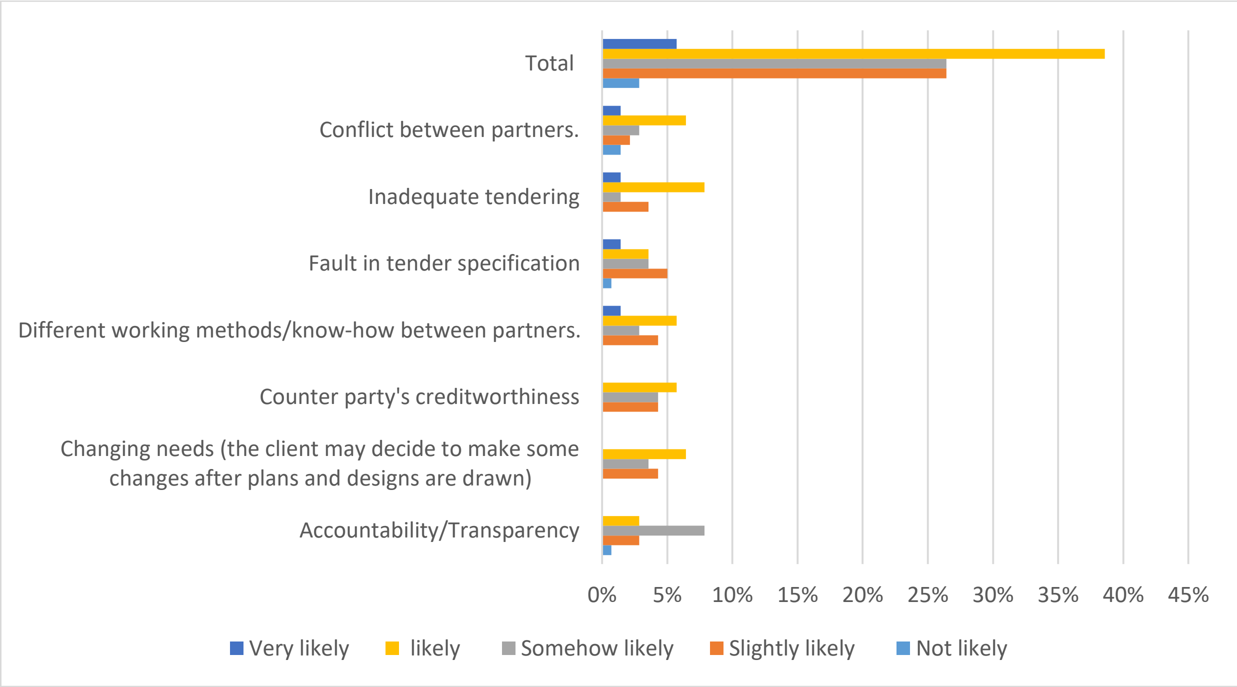

Figure 6. 3: Probability of Contractual Risks - Source: Author (2020)

6.5.1.1 Contractual Risks – Impact/Effect on Project development of HPP/PPP.

The impact of contractual risks on the development of hydropower projects was seen to be **'substantial'** with a score of 59/140 (42%). Accountability/transparency was the highest contributor to the impact of contractual risks, accounting for 15/140 (11%).

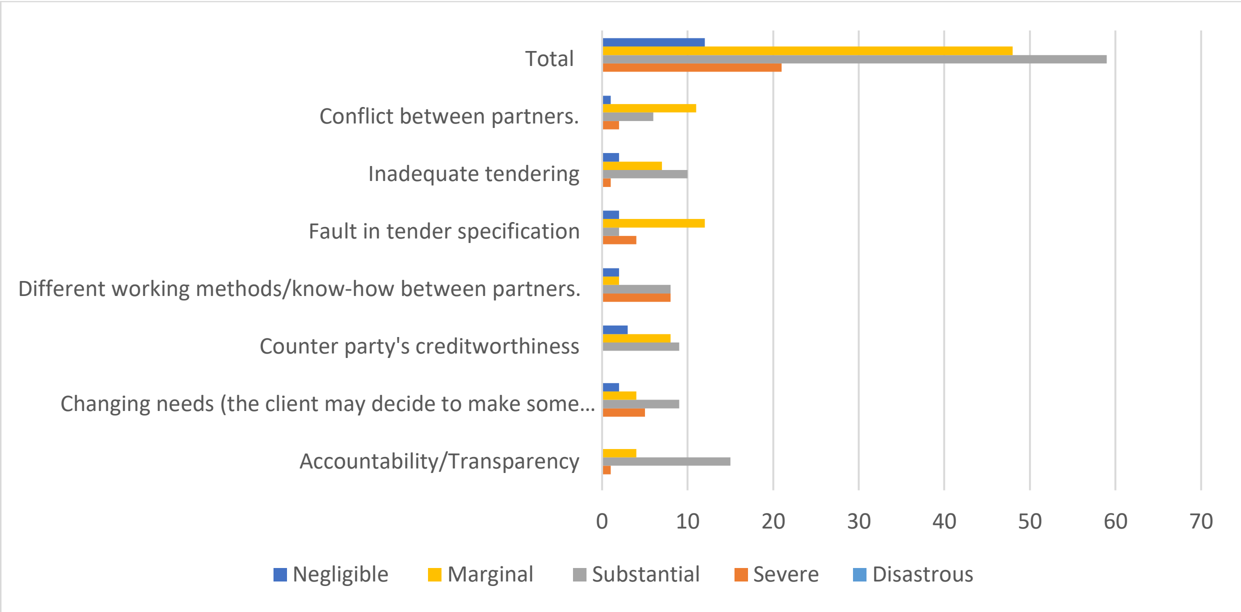

Figure 6. 4: Impact of Contractual Risks - Source: Author (2020)

6.4.3 Financial Risks - Probability/likelihoods of Occurrence

The study showed that financial risks were '**likely** to happen (39%). Other probability occurrence chances were rated as follows: somehow likely (25%), very likely (18%), slightly likely (14%), and not likely (5%). High bidding costs and local currency devaluation were the highest contributors to the occurrence of financial risks, accounting for 13% and 11% respectively.

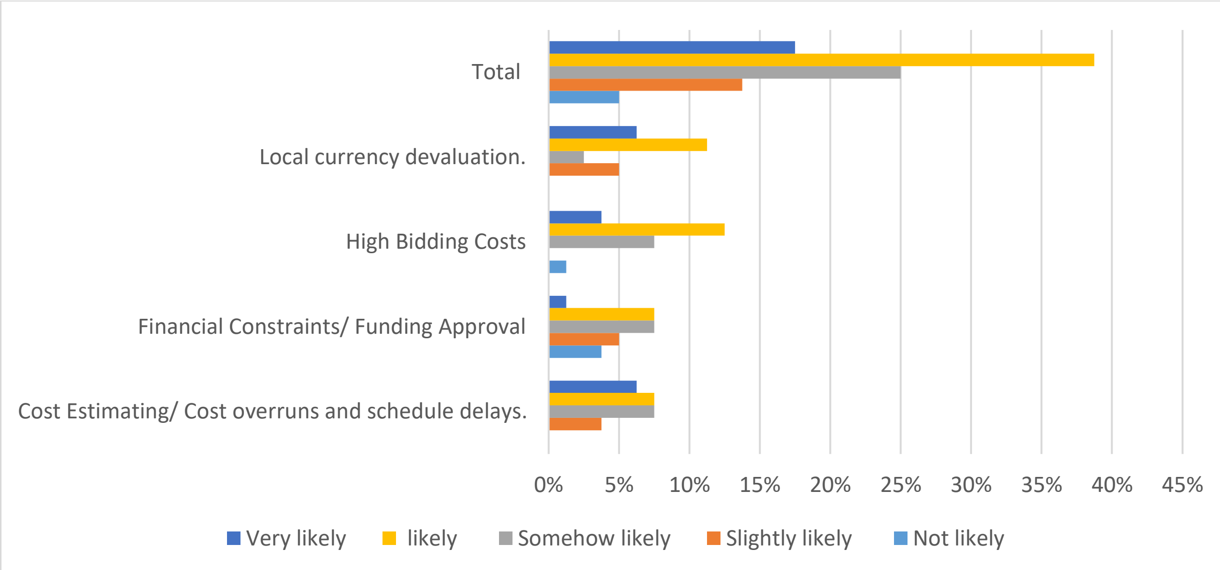

Figure 6. 5: Probability of Financial Risks - Source: Author (2020)

6.5.3.1 Financial Risks - Impact/Effect on Project development of HPP/PPP.

The impact of financial risks on the development of hydropower projects was seen to be 'severe' with a score of 30/80 (38%). Cost overruns and schedule delays were the highest contributors to the impact of financial risks, accounting for 13/80 (16%).

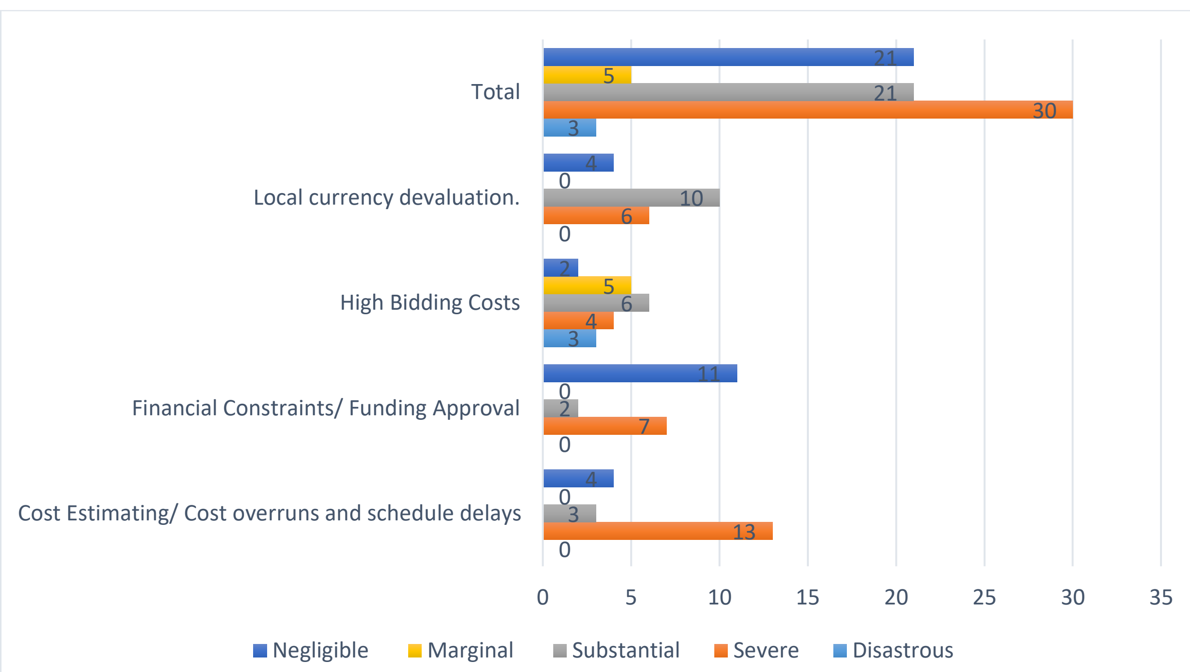

Figure 6. 6: Impact of Financial Risks - Source: Author (2020)

6.5.4 Economic Risks - Probability/likelihoods of Occurrence

The occurrence of economic risks in hydro-power projects was **'likely'** with an occurrence chance of 38%. Other probability occurrences had lesser scores as follows: slightly likely (21%), somehow likely (16%), not likely (13%), and very likely (12%). Interest rates and exchange rate fluctuations accounted for the highest contribution to the occurrence of economic risks.

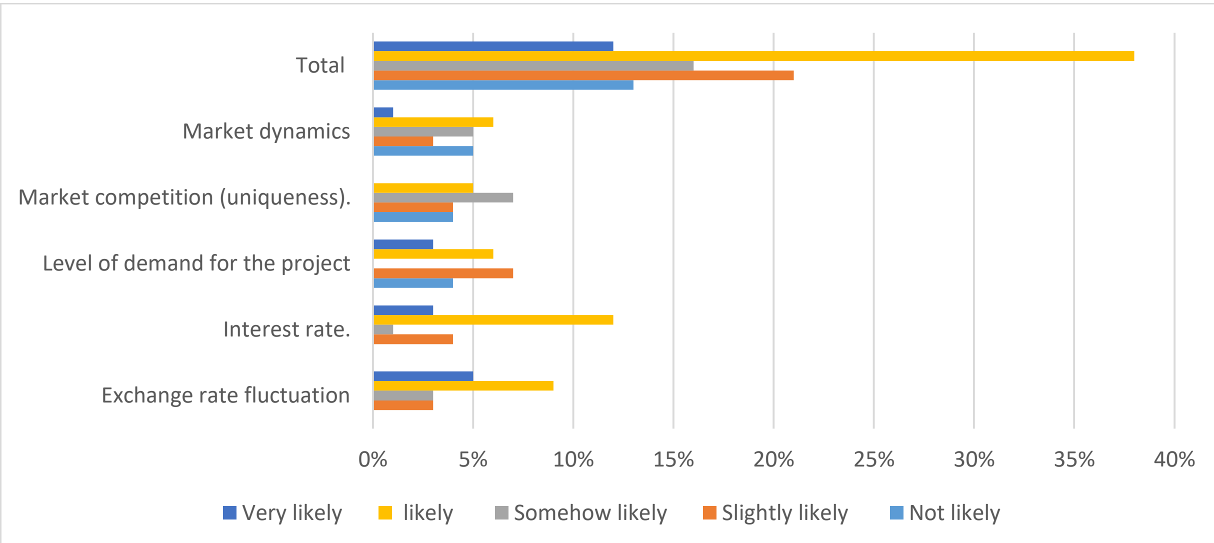

Figure 6. 7: Probability of Economic Risks - Source: Author (2020)

6.5.4 Economic Risks - Impact/Effect on Project development of HPP/PPP.

The impact of economic risks on the development of hydropower projects was seen to be 'substantial' with a score of 43/100 (43%). Interest rate and exchange rate fluctuations were the highest contributors to the impact of economic risks accounting for 12/100 (12%) and 11/100 (11%) respectively.

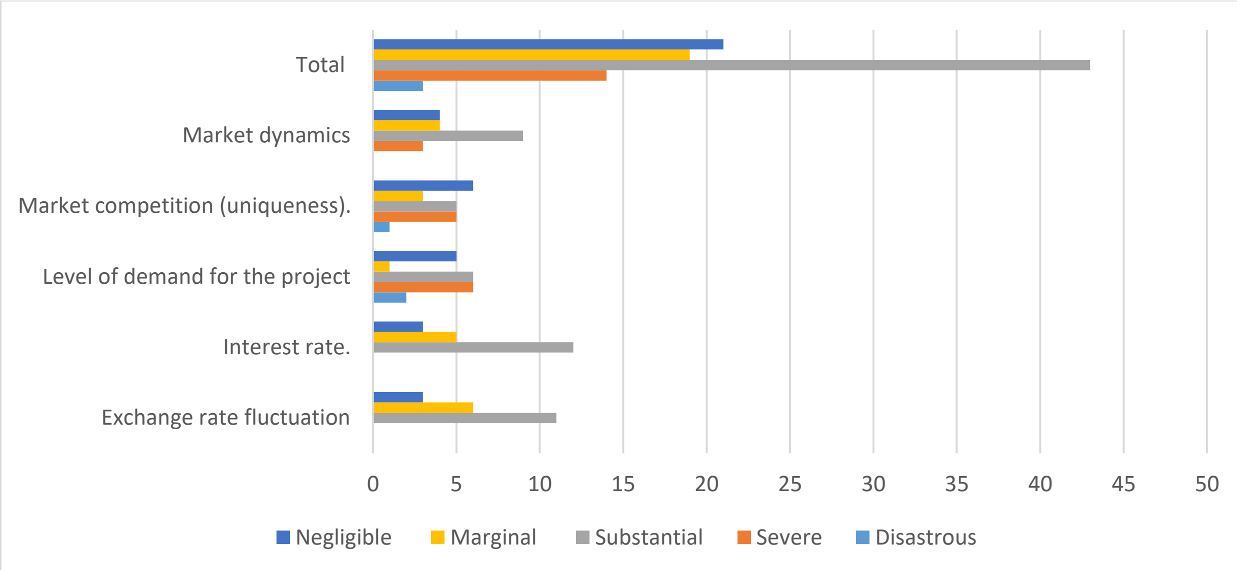

Figure 6. 8: Impact of Economic Risks - Source: Author (2020)

6.5.5 Political Risks - Probability/likelihoods of Occurrence

The study showed that political risks were ‘somehow likely’ to happen (38%). Other probability occurrence chances were rated as follows: likely (25%), very likely (19%), slightly likely (14%), and not likely (4%). Administration red tape and public opposition were the highest contributors towards the occurrence of political risks, accounting for 11% and 10% respectively.

Figure 6.9 shows the likelihood of the occurrence of political risks in the development stages of hydropower projects:

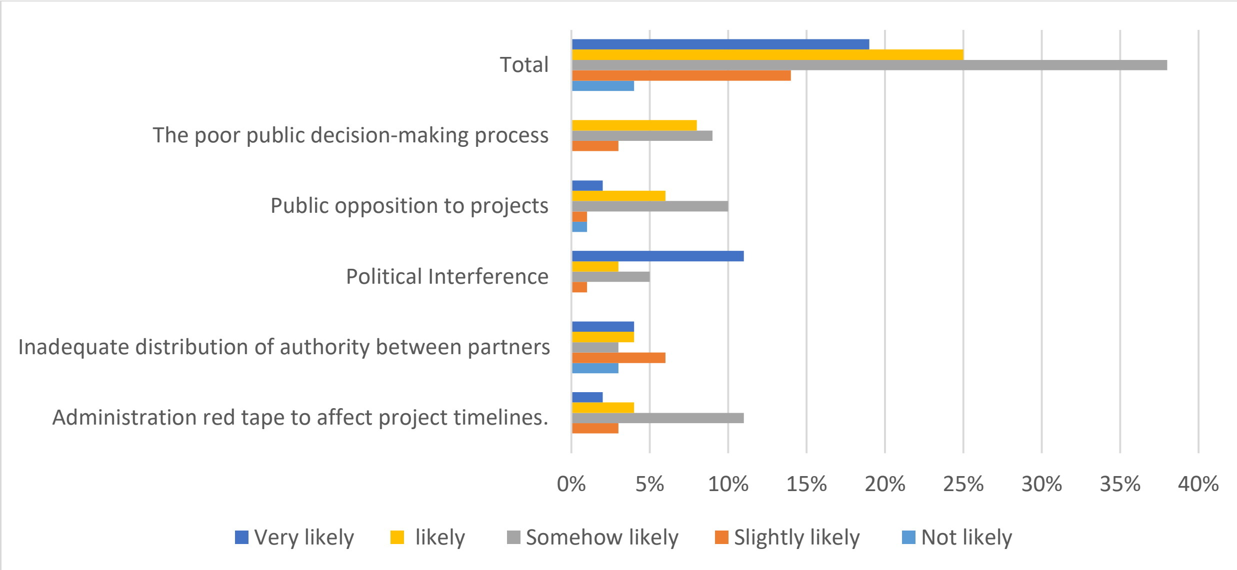

Figure 6. 9: Probability of Political Risks - Source: Author (2020)

6.5.5.1 Political Risks - Impact/Effect on Project development of HPP/PPP.

The impact of political risks on the development of hydropower projects was seen to be 'substantial' with a score of 45/100 (45%). Inadequate distribution of authority between partners was the highest contributor to the impact of political risks accounting for 15/100 (15%). Figure 6.10 shows the impact of political risks in the development stages of hydropower projects:

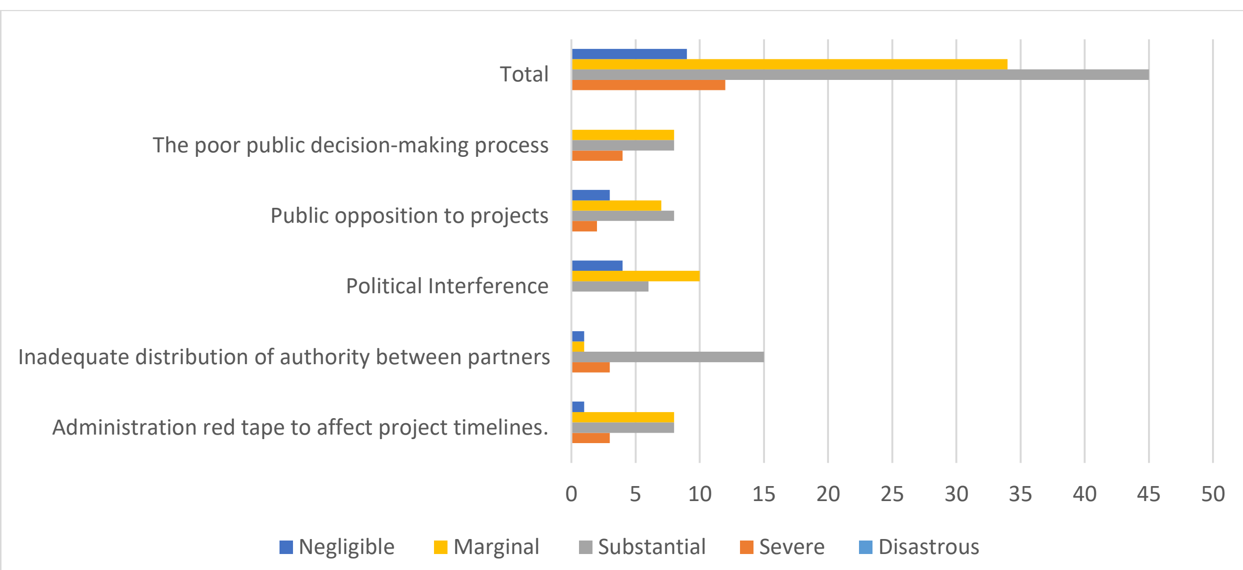

Figure 6. 10: Impact of Political Risks - Source: Author (2020)

6.5.6 Social/Environmental Risks- Probability/likelihoods of Occurrence

The study showed that social/environmental risks were ‘likely to happen (42%). Other probability occurrence chances were rated as follows: somehow likely (19%), very likely (11%), slightly likely (22%), and not likely (6%). Corruption and land acquisition and compensation problems were the highest contributors to the occurrence of social/environmental risks, accounting for 15% and 11% respectively. Figure 6.11 shows the likelihood of the occurrence of Social/Environmental risks in the development stages of hydropower projects:

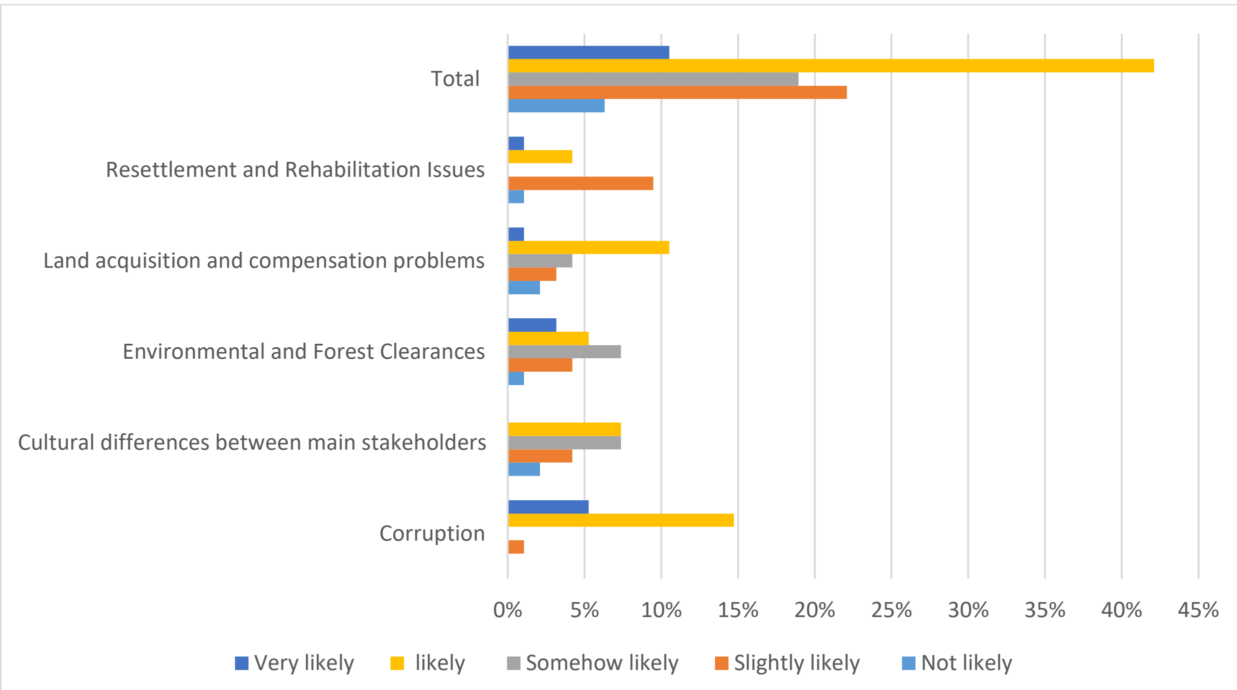

Figure 6. 11: Probability of Social/Environmental Risks - Source: Author (2020)

6.5.6.1 Social/Environmental Risks- Impact/Effect on Project development of HPP/PPP.

The impact of social/environmental risks on the development of hydropower projects was seen to be ‘substantial’ with a score of 40/100 (40%). Cultural differences between main stakeholders were the highest contributor to the impact of Social/ Environmental risks accounting for 20/100 (20%). Chart 6.12 shows the impact of Social/Environmental risks in the development stages of hydropower projects:

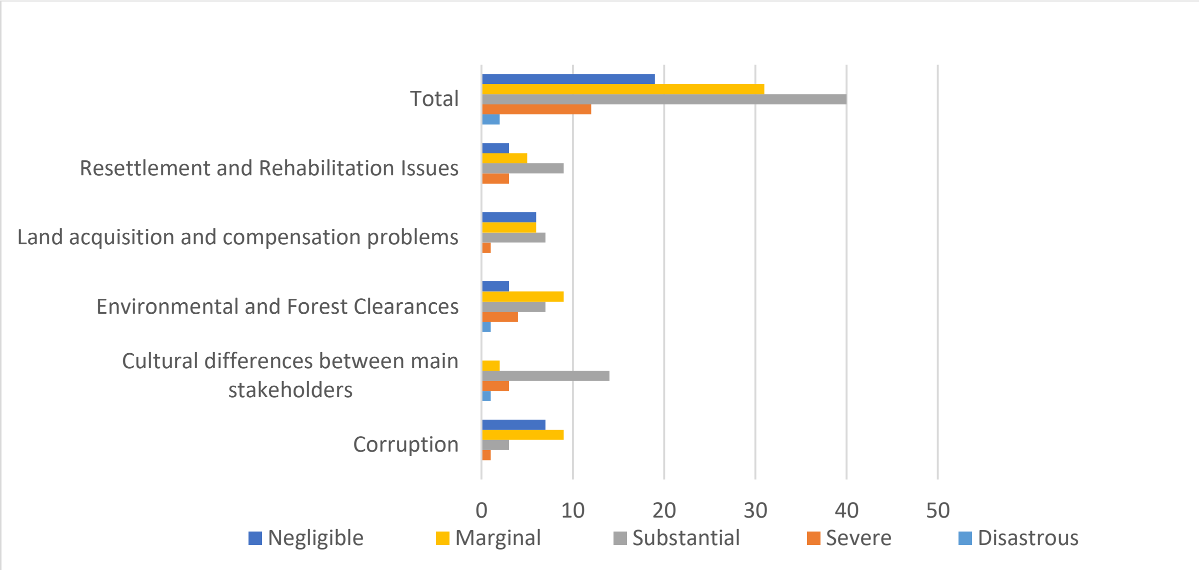

Figure 6. 12: Impact of Social/Environmental Risks - Source: Author (2020)

6.5.7 Regulatory and Legal Risks- Probability/likelihoods of Occurrence

The study showed that technical risks were **'somehow likely'** to happen (42%). Other probability occurrence chances were rated as follows: likely (27%), very likely (2%), slightly likely (24%), and not likely (5%). Delay in project approvals and permits, as well as inadequate design details, were the highest contributors towards the occurrence of regulatory and Legal risks, accounting for 14% and 8% respectively.

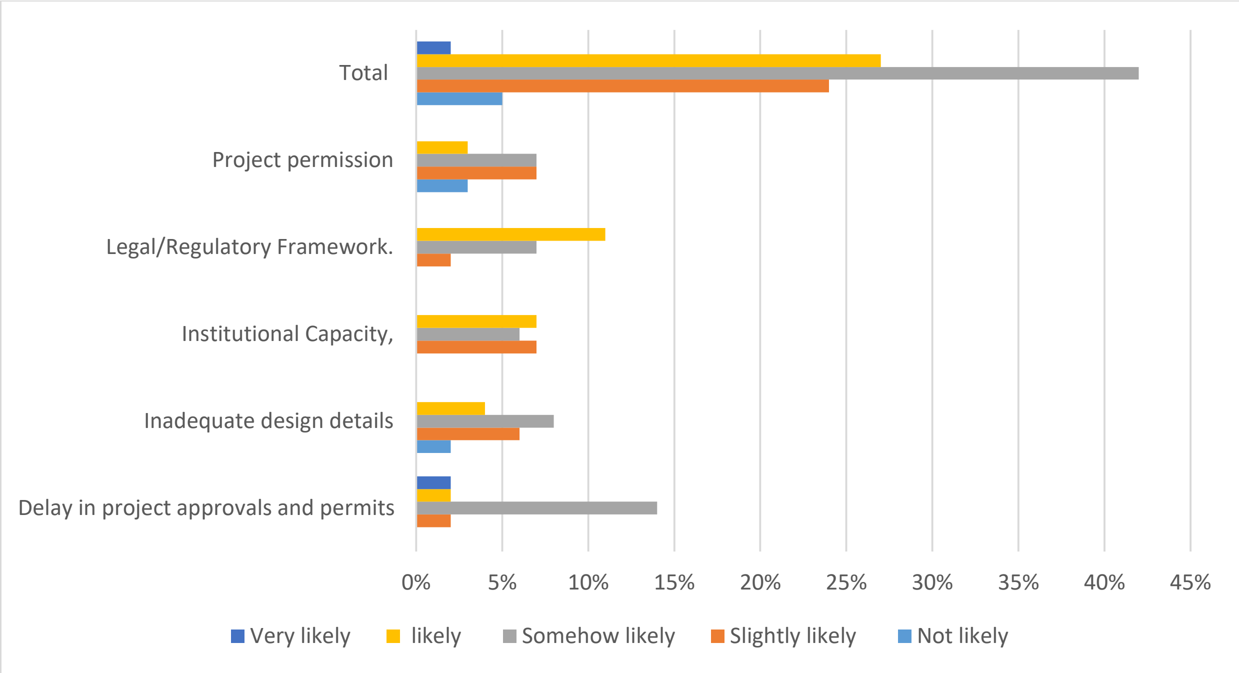

Figure 6. 13: Probability of Regulatory and Legal Risks - Source: Author (2020)

6.5.7.1 Regulatory and Legal Risks- Impact/Effect on Project development of HPP/PPP.

The impact of regulatory and legal risks on the development of hydropower projects was seen to be **'substantial'** with a score of 31/100 (31%). Project permission was the highest contributor to the impact of regulatory and legal risks accounting for 10/100 (10%).

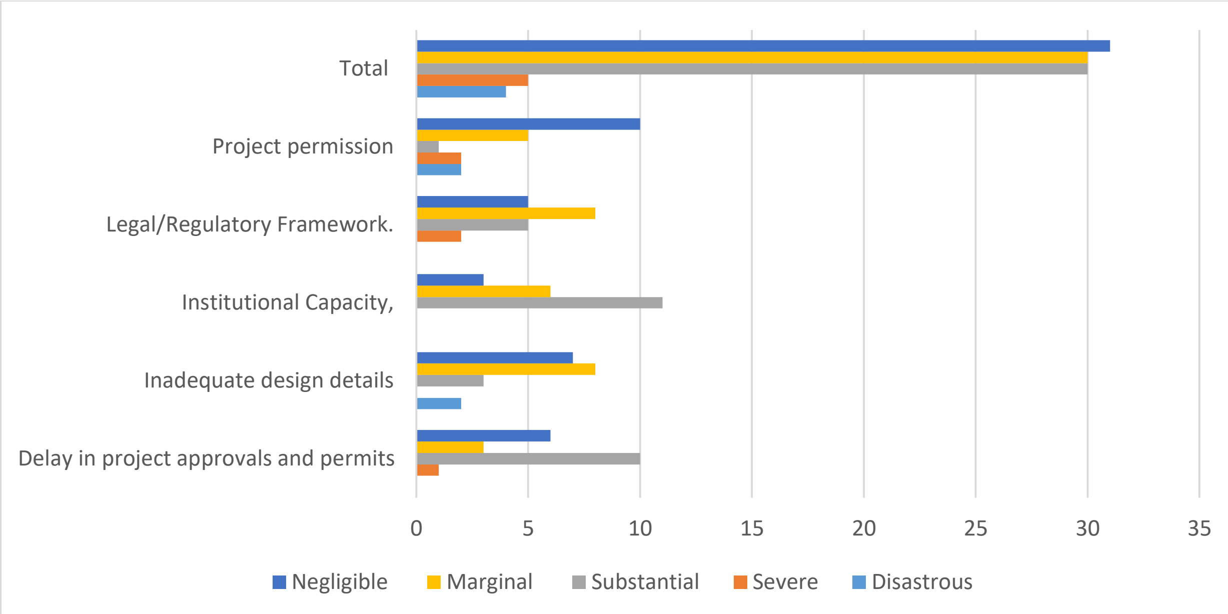

Figure 6. 14: Impact of Regulatory and Legal Risks - Source: Author (2020)

6.5.8 Technical Risks - Probability/likelihoods of Occurrence

The study showed that technical risks were 'somehow likely' to happen (36%). Other probability occurrence chances were rated as follows: likely (19%), very likely (6%), slightly likely (24%), and not likely (16%). Incompetent project team and hydrology were the highest contributors towards the occurrence of technical risks, accounting for 8% and 6% respectively.

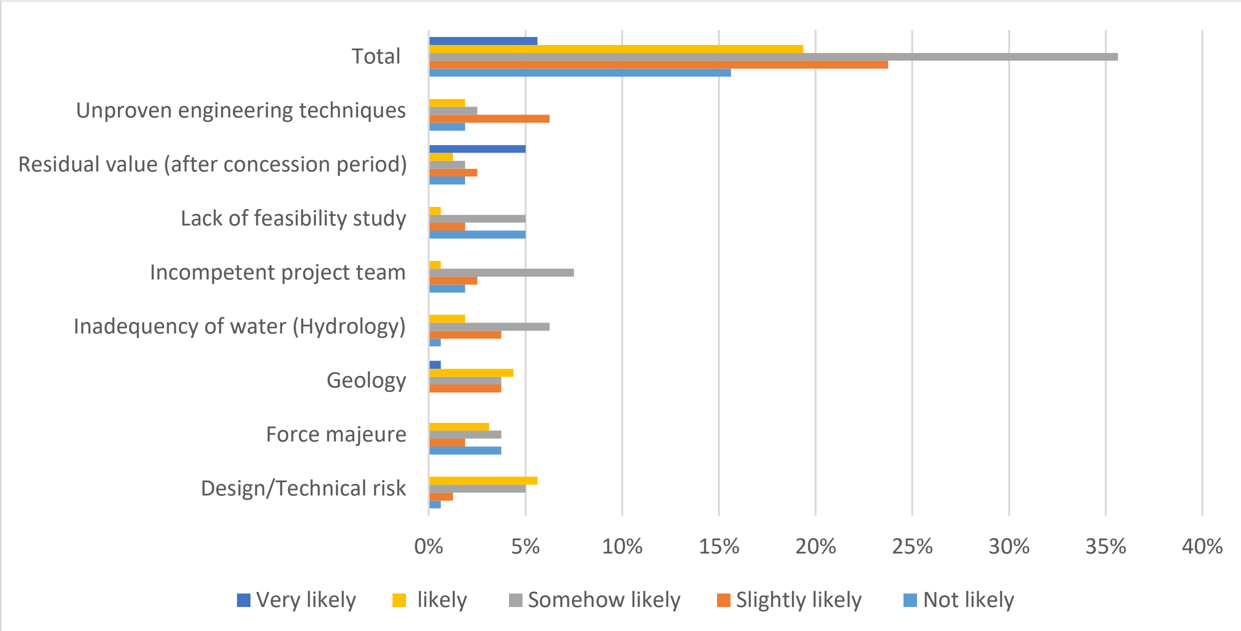

Figure 6. 15: Probability of Technical Risks - Source: Author (2020)

6.5.8.1 Technical Risks - Impact/Effect on Project development of HPP/PPP.

The impact of technical risks on the development of hydropower projects was seen to be **'severe'** with a score of 68/160 (43%). Geology and technical design were the highest contributors to the impact of technical risks accounting for 15/160 (9%) and 12/160 (7.5%) respectively.

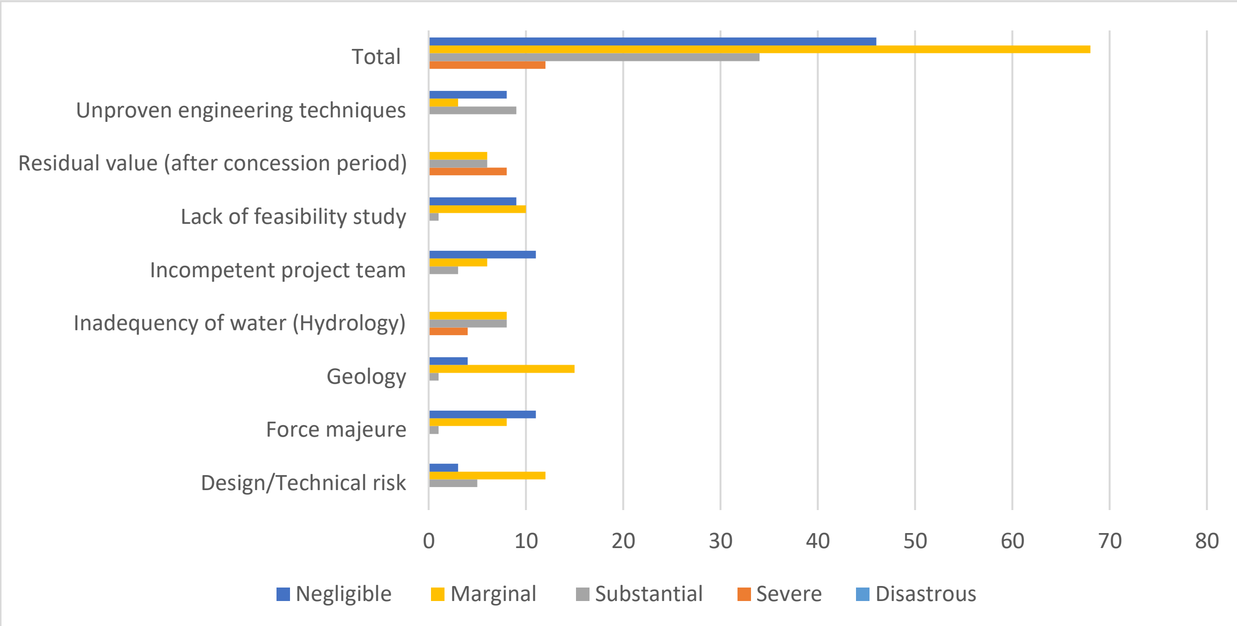

Figure 6. 16: Impact of Technical Risks - Source: Author (2020)

6.6. Developing techniques for a risk management framework suitable for Zambia Hydro Power Projects implementation through PPP.

6.6.1 Technical Inputs

This section shows the findings of the study from the technical input aspects which were collected using the second questionnaire. The section presents characteristics of the experts together with the study findings regarding the assessment of the technical inputs required to develop the risk management framework. These technical input factors were among the significant knowledge gap which was established by this research. The motivation for collecting technical data was to establish whether the characteristics of experienced stakeholders, features of institutional capacity, elements of private party appraisal and due diligence and essentials of technical project proposal appraisal contributed to the successful development of technical input requirements for a risk management framework for the PPP Construction of hydro-power projects.

Technical inputs were analyzed using a five-point Likert scale (namely 1 = strongly agree, 2 = agree, 3 = undecided, 4 = disagree, and 5 = strongly disagree). To carry out the analysis using the

Likert scale, a score of 3.0 was assumed to be the mid-point of the Likert distribution. Therefore, values above 3 were assumed to approximate the level of disagreement while values below 3 were assumed to approximate the level of agreement with the statements provided under each technical input assessment.

6.6.2 Characteristics of Technical Experts

Sixty (60) technical experts responded to the questionnaire. Of the total number of the respondents, the majority were Government officials and Consultants accounting for 35.0 % and 31.7 % respectively, as shown in Table 6.25:

Table 6. 25: Characteristics of Technical Experts

	Characteristics of experts	**Number**	**Per cent**
Role In Public-Private Partnership Projects	Project Finance	3	5.0
	Government Official	21	35.0
	Sponsor	3	5.0
	Regulator	1	1.7
	Policy formulation	3	5.0
	Contractor	10	16.7
	Consultant	19	31.7
	Total	**60**	**100.0**
Period An Organization has Been In Business	Less 5	14	23.3
	5 – 10	11	18.3
	11 – 15	12	20.0
	16 – 20	7	11.7
	21 and older	16	26.7
	Total	**60**	**100.0**
Highest Academic Qualification	Diploma	1	1.7
	Under Graduate Degree	43	71.7
	Post Graduate (Master's Degree or PhD)	16	26.7
	Total	**60**	**100.0**

Source: Author (2020)

The majority of the technical experts (26.7%) were associated with organizations that had been in business for at least 21 years while 23.3% were associated with organizations that had been in business for only less than 5 years. Further, of most of the technical experts, about 72% held the undergraduate degree as their highest academic qualification with only about 2% and 27% holding diploma and Postgraduate degree qualifications respectively.

6.6.3 Experience of Stakeholders (SE)

Table 6. 26: Technical Experts View On Stakeholder Experience

	Role In Public-Private Partnership Projects							
	Total	**Project Finance**	**Government Official**	**Sponsor**	**Regulator**	**Policy formulation**	**Contractor**	**Consultant**
Stakeholder experience	**2.20**	**1.28**	**2.32**	**1.72**	**2.00**	**1.94**	**2.38**	**2.25**
Compatible levels of technical expertise.	2.23	1.00	2.38	1.67	1.00	1.67	2.80	2.21
Common vision and objective.	2.07	1.33	2.29	2.33	2.00	2.00	1.90	2.00
Identified pre-determined goals or outcomes for the partnership.	2.00	1.33	2.10	1.67	2.00	1.67	1.90	2.16
Appropriate performance indicators for which data is available and collection is feasible.	2.18	1.33	2.29	1.00	1.00	1.67	2.40	2.42
Efficient knowledge and information management.	2.12	1.33	2.00	1.67	2.00	2.00	2.50	2.26
Cultures that embrace collaboration.	2.62	1.33	2.86	2.00	4.00	2.67	2.80	2.47

Source: Author (2020)

The aim of interviewing technical experts was to determine whether the experience of stakeholders contributed to the development of technical inputs for a risk management model for PPP Construction - hydropower projects success. Overall findings revealed that technical experts agreed (with a Likert scale of 2.20) that stakeholder experience (SE) contributes to the development of technical inputs for a risk management framework for PPP Construction - hydropower projects success. The contribution of stakeholder experience to the development of technical inputs for a risk management model was highly supported by contractors, government officials, and consultants. Table 6.26 shows the results:

6.6.4 Institutional Capacity (IC)

The other aim of interviewing technical experts was to determine whether the institutional capacity contributed to the development of technical inputs for a risk management framework for PPP Construction - hydropower projects success. Overall findings revealed that technical experts agreed (with a Likert scale of 2.37) that institutional capacity (IC) contributes to the development of technical inputs for a risk management model for PPP Construction - hydropower projects success. The contribution of institutional capacity to the development of technical inputs for a risk management model was highly supported by consultants, contractors, and sponsors.

Table 6.27 shows the results:

Table 6. 27: Technical Experts View On Institutional Capacity

	Role in Public-Private Partnership Projects							
	Total	**Project Finance**	**Government Official**	**Sponsor**	**Regulator**	**Policy formulation**	**Contractor**	**Consultant**
Institutional Capacity	**2.37**	**1.17**	**2.24**	**2.56**	**2.17**	**1.94**	**2.52**	**2.67**
Transparency and accountability.	2.25	1.33	2.24	2.33	1.00	1.67	2.20	2.58
Outcomes-based performance measurement and management.	2.38	1.00	2.33	2.00	1.00	2.33	2.20	2.89
Contractual arrangement in place.	2.10	1.00	1.95	2.67	3.00	1.67	2.30	2.26
Defined structural relationships.	2.27	1.33	2.10	2.33	2.00	1.67	2.60	2.53
Favourable internal political environment.	2.73	1.33	2.67	3.00	4.00	2.67	2.90	2.84
Well-defined procurement process.	2.47	1.00	2.14	3.00	2.00	1.67	2.90	2.89

Source: Author (2020)

6.6.5 Private Party Appraisal and Due Diligence (PPADD)

Further, interviewing technical experts was to determine whether the private party appraisal and due diligence contribute to the development of technical inputs for a risk management framework for PPP Construction - hydropower projects success. Table 6.28 shows the results:

Table 6. 28: Technical Experts View On Private Party Appraisal and Due Diligence

	Role in Public-Private Partnership Projects							
	Total	**Project Finance**	**Government Official**	**Sponsor**	**Regulator**	**Policy formulation**	**Contractor**	**Consultant**
Private party Appraisal and Due diligence	**2.18**	**1.44**	**2.02**	**2.22**	**1.33**	**1.56**	**2.42**	**2.49**
Financial capacity.	1.88	1.33	1.71	2.33	1.00	1.33	2.00	2.16
Organizational cultures are receptive to the partnership.	2.42	1.33	2.43	2.00	2.00	2.00	2.80	2.53
A focus on positive goals, positive social impact, and the public good.	2.35	1.33	2.29	2.33	1.00	2.00	2.40	2.68
Adequate technical skills, Innovations, and managerial capacity.	2.15	1.67	1.95	2.33	2.00	1.33	2.40	2.42
Clarity and openness about collective agendas and purpose.	2.22	1.67	2.00	2.00	1.00	1.33	2.40	2.68
Clearly defined project organization structure.	2.08	1.33	1.76	2.33	1.00	1.33	2.50	2.47

Source: Author (2020)

Overall findings revealed that technical experts agreed (with a Likert scale of 2.18) that PPADD contributes to the development of technical inputs for a risk management model for PPP Construction - hydropower projects success. The contribution of private party appraisal and due diligence to the development of technical inputs for a risk management model was highly supported by consultants, contractors, and sponsors.

6.6.6 Technical Project Proposal Appraisal (TPPA)

The technical experts were interviewed to determine whether Technical Project Proposal Appraisal contributes to the development of technical inputs for a risk management framework for PPP Construction - hydropower projects success. Table 6.29 shows the results:

Table 6. 29: Technical Experts View On Technical Project Proposal Appraisal

	Role in Public-Private Partnership Projects							
	Total	**Project Finance**	**Government Official**	**Sponsor**	**Regulator**	**Policy formulation**	**Contractor**	**Consultant**
Technical Project Proposal Appraisal	**2.39**	**1.50**	**2.46**	**2.56**	**1.50**	**1.61**	**2.88**	**2.32**
Flexible contracts with simple, robust contract variation procedures.	2.70	2.00	2.76	2.33	2.00	1.67	2.90	2.89
Flexibility - renegotiating outcomes based on changing conditions.	2.98	2.00	3.86	2.67	1.00	1.67	2.60	2.74
An assured project financing stream for the duration of the partnership.	2.12	1.33	2.00	3.00	1.00	1.33	2.70	2.11
Fully understanding the business at hand, for example, hydropower.	1.93	1.67	1.76	3.00	2.00	1.33	2.50	1.79
Value for money- Delivery of affordable services not exceeding public provision costs.	2.43	1.00	2.38	2.00	2.00	2.33	3.30	2.37
Integrated risk management - clear and fair risk balance.	2.15	1.00	2.00	2.33	1.00	1.33	3.30	2.05

Source: Author (2020)

Overall findings revealed that technical experts agreed (with a Likert scale of 2.39) that technical project proposal appraisal contributes to the development of technical inputs for a risk management model for PPP Construction - hydropower projects success. The contribution of TPPA to the development of technical inputs for a risk management framework was highly supported by contractors, sponsors, and government officials.

6.7 Multiple Regression Analysis

The study used multiple regression analysis to measure relationships between the independent and dependent variables and determine the degree of association among them. It was justified for the study to use multiple regression analysis since it is an appropriate method for measuring the degree of association between the dependent variable and two or more independent variables. Thus, the methodology was employed to establish how stakeholder experience, institutional capacity, PPADD, and TPPA influenced the development of technical inputs for a risk management framework for the successful construction of PPP hydropower projects.

6.7.1 Hypotheses of the Study

A total of 22 hypotheses shown in table 6.30 were designed to guide the findings of the study:

Table 6. 30: Hypotheses for the Study

H1: There is a significant correlation between SE and project scope
H2: There is a significant correlation between SE and project completion time
H3: There is a significant correlation between SE and project budget
H4: There is a significant correlation between SE and project quality
H5: There is a significant correlation between SE and stakeholder satisfaction
H6: There is a significant correlation between IC and project scope
H7: There is a significant correlation between IC and project completion time
H8: There is a significant correlation between the IC and the project budget
H9: There is a significant correlation between IC and project quality
H10: There is a significant correlation between IC and stakeholder satisfaction
H11: There is a significant correlation between PPADD and project scope
H12: There is a significant correlation between PPADD and project completion time
H13: There is a significant correlation between PPADD and project budget
H14: There is a significant correlation between PPADD and project quality
H15: There is a significant correlation between PPADD and stakeholder satisfaction
H16: There is a significant correlation between TPPA and project scope
H17: There is a significant correlation between TPPA and project completion time
H18: There is a significant correlation between TPPA and project budget
H19: There is a significant correlation between TPPA and project quality
H20: There is a significant correlation between TPPA and stakeholder satisfaction
H21: There is a significant correlation between project outputs and project outcomes (value for money).
H22: There is a significant correlation between project outputs and project outcomes (sustainability).

Source: Author 2020

6.7.2 Decision Rule

In measuring the strong relationship between the dependent variable and the independent variables, multiple regression coefficient correlations (R) were calculated, being guided by the principles that: R = 1 indicates a perfect linear relationship while R = 0 indicates no linear relationship whatsoever. A multiple regression coefficient value of at least 0.5 (50.0%) were regarded as the minimum value for a variable to be valid for the model. Further, the adjusted R-squared was used to explain the extent of association between the dependent and independent variables. Adjusted R-squared was preferred over R-squared (coefficient of determination) because it is known to give more accurate results being a more conservative estimate. Finally, acceptance of the hypotheses of the study was based on a comparison of the calculated p-value against the standard p-value (0.05). If the calculated p-value was found to be less than 0.05, the hypotheses were accepted as per the standard rule.

6.8 Framework/ Model Testing

To develop a risk management framework/model for PPP construction - hydropower project success, it was imperative to understand the existence of correlations between the independent and dependent variables and the amount of influence that independent variables have on dependent variables. The unstandardized coefficient values were computed to enable the researcher to understand the extent to which a dependent variable varies concerning a unit change in the latent independent variable. There was also a need to understand whether such correlations were significant or insignificant. Thus both multiple regression analysis and hypothesis testing were employed in this study to test and develop the appropriate model. The rest of this chapter tests the appropriateness of the model based on the above-stated approaches which are based on correlations and significance.

6.8.1 Stakeholder Experience

6.8.1.1 Correlations between Stakeholder Experience and Scope

The model summary table 6.30 presents correlations between stakeholder experience and project scope. There was a strong positive correlation between stakeholder experience and project scope, indicated by the correlation coefficient (R) value of 0.822. The computed adjusted R Square value of 0.639 showed that approximately 64.0% of the variability in project scope was attributed to stakeholder experience with the rest being due to factors not mentioned in the study. Thus stakeholder experience was regarded as a major factor. On the other hand, the association between stakeholder experience and project scope was statistically significant as indicated by a p-value of 0.000 (Anova table). This association implied that the regression model was a good fit for the data being analyzed.

An analysis of the individual variables of stakeholder experience relative to project scope revealed that only compatible levels of technical expertise exhibited a significant relationship (p = 0.000) and had a corresponding unstandardized coefficient value of 0.914. It was construed that effecting a unit increase in incompatible levels of technical expertise could enhance the accuracy of project scoping by 0.914 assuming all other independent variables remained constant. Considering that the rest of the independent indicator variables had p-values greater than 0.05, they were not incorporated into the model as they were incapable of predicting scope.

Table 6. 31: Model Summary: Correlations Between Stakeholder Experience and Project Scope

Model	R	R Square	Adjusted R Square	Std. The error of the Estimate
1	.822	.675	.639	.745

Source: Author (2020)

6.8.2 Correlations Between Stakeholder Experience and Project Completion Time

From the model summary presented in Table 6.32, a strong positive correlation existed between predictor variables of stakeholder experience and project completion time (R = 0.985). The Adjusted R Square showed that 96.8% of variations in stakeholder experience could be explained by project completion time. The relationship between stakeholder experience and project completion time is statistically significant as indicated by a p-value of 0.000, implying that the regression model is a good fit for the data being analyzed.

Apart from compatible levels of technical expertise (p = 0.000), all other latent variables of stakeholder experience did not show significant relationships ($p<0.05$) and were thus not considered as part of the model. The unstandardized coefficient of 0.999 implied that a unit increase incompatible levels of technical expertise could improve the completion project's time by 0.999 provided the rest of the latent independent variables remain unchanged.

Table 6. 32: Model Summary: Correlations Between Stakeholder Experience and Project Completion Time

Model	R	R Square	Adjusted R Square	Std. The error of the Estimate
1	.985	.971	.968	.220

Source: Author (2020)

6.8.3 Correlations Between Stakeholder Experience and Project Budget

There was a very strong positive correlation between stakeholder experience predictor variables and the project budget indicated by R = 0.985. The Adjusted R Square value showed that 92.4% of project cost variability can be explained by stakeholder experience. The relationship was also statistically significant with a p-value of 0.000, implying that the regression model was a good fit for the data being analyzed. However, apart from compatible levels of technical expertise (p =0.000), all other latent variables of stakeholder experience did not show significant relationships ($p<0.05$) and were thus not considered as part of the model. The unstandardized coefficient of 0.930 implied that a unit increase in incompatible levels of technical expertise could improve the project's budget by 0.930 provided the rest of the latent independent variables remain unchanged. Other latent independent variables cannot be used to predict the budget of the project as they are not significant (since their p-values > 0.05).

Table 6. 33: Model Summary: Correlations Between Stakeholder Experience and Project Budget

Model	R	R Square	Adjusted R Square	Std. The error of the Estimate
1	.965	.932	.924	.331

Source: Author (2020)

6.8.4 Correlations Between Stakeholder Experience and Project Quality

The model summary as per Table 6.34 shows the existence of a very strong positive correlation between stakeholder experience predictor variables and project quality as indicated by R = 0.968. The Adjusted R Square value implied that 92.9% of the variability in project quality could be explained by stakeholder experience. With a p-value of 0.000, the relationship between stakeholder experience and project quality was statistically significant, suggesting that the regression model is a good fit for the data being considered. Apart from compatible levels of technical expertise (p =0.000), all other stakeholders experience latent variables that failed to show significant relationships (p<0.05 (i.e. could not be used to predict the quality of the project); hence they were not considered as part of the formulated study model. An unstandardized coefficient of 0.873 showed the amount of improvement in quality that could result from a unit increase incompatible levels of technical expertise.

Table 6. 34:Model Summary: Correlations Between Stakeholder Experience and Project Quality

Model	R	R Square	Adjusted R Square	Std. The error of the Estimate
1	.968	.937	.929	.313

Source: Author (2020)

6.8.5 Correlations Between Stakeholder Experience and Satisfaction of Stakeholders

There was a very strong relationship between predictor variables of stakeholder experience and stakeholder satisfaction as indicated by R = 0.967 in the model summary above. The Adjusted R Square value showed that 0.928 (92.8%) of variability in stakeholder satisfaction could be explained by stakeholder experience. The relationship was also statistically significant (with a p-value of 0.000), signifying that the regression model was a good fit for the data being considered. Apart from compatible levels of technical expertise, other stakeholder experience latent variables could not show significant relationships ($p<0.05$) (i.e. cannot be used to predict stakeholder satisfaction); hence their exclusion from the formulated model.

The unstandardized coefficient of 0.914 showed the improvement in stakeholder satisfaction that could result from a unit increase incompatible levels of technical expertise provided other latent independent variables remained constant.

Table 6. 35: Model Summary: Correlations Between Stakeholder Experience and Satisfaction of Stakeholders

Model	R	R Square	Adjusted R Square	Std. The error of the Estimate
1	.967	.935	.928	.324

Source: Author (2020)

6.9 Institutional Capacity

6.9.1 Correlations Between Institutional Capacity and Scope

The model summary table 5.36 shows the existence of a moderate positive correlation between Institutional capacity and project scope as indicated by R = 0.625. The adjusted R Square value demonstrated that only 0.321 (32.1%) of the variability in project scope was explained by institutional capacity. The relationship between independent variables and the scope was statistically significant (with a p-value of 0.000), implying that the regression model was a good fit for the data being studied.

An analysis of latent variables of institutional capacity and project scope showed transparency and accountability had a significant correlation with a p-value of 0.000. The unstandardized coefficient value for transparency and accountability was 0.412, showing the amount by which scope accuracy could improve due to a unit increase in transparency and accountability provided the rest of the independent variables were kept constant. On the contrary, the rest of the independent variables of institutional capacity cannot be used to predict scope as they were not significant having p-values are greater than 0.05.

Table 6. 36: Model Summary: Correlations Between Institutional Capacity and Project Scope

Model	R	R Square	Adjusted R Square	Std. The error of the Estimate
1	.625	.390	.321	1.021

Source: Author (2020)

6.9.2 Correlations Between Institutional Capacity and Project Completion Time

From the model summary table 6.37, a strong positive linear relationship was observed between predictor variables of institutional capacity and project completion time indicated by R = 0.769. The Adjusted R Square value implied that institutional capacity could account for 54.5% of project duration variability, with the remaining 45.5% of variability attributed to factors other than the ones presented in the study. The association between institutional capacity and project duration was also statistically significant (with a p-value of 0.000), denoting that the regression model is was a good fit for the data being analyzed.

Analysis of the results showed three variables namely transparency and accountability, defined structural relationships and well-defined procurement process had significant relationships with project duration (having p values <0.05). The rest of the variables had insignificant relationships and were not considered to be part of the model to be formulated. Unstandardized coefficients of 0.528, 0.390, and -0.322 attributed to the significant variables showed the number of improvements in project completion times that a unit increase in each of the independent variables (transparency and accountability, defined structural relationships, and well-defined procurement process) was able to achieve, provided the rest of the latent independent variables remained unchanged. The other latent independent variables cannot be used to predict the completion time of the project as they are not significant due to having p-values that are greater than 0.05).

Table 6. 37 : Model Summary: Correlations Between Institutional Capacity and Project **Completion Time**

Model	R	R Square	Adjusted R Square	Std. The error of the Estimate
1	.769	.591	.545	.828

Source: Author (2020)

6.9.3 Correlations Between Institutional Capacity and Project Budget

From the results shown in the model summary table 6.38, R = 0.769 indicates a strong positive linear correlation between predictor variables of institutional capacity and project budget. This implies that as institutional capacity improved, similar positive changes were observed in the project budget. Additionally, the Adjusted R Square value of 0.544 was computed meaning institutional capacity was accounting for 54.4% of project cost/budget variability, with the remaining 45.6% of variability attributed to factors other than the ones accessible in the study. The relationship between institutional capacity and project budget established that both variables were statistically significant (with a p-value = 0.000) showing that the regression model is a good fit for the data being analyzed.

From further analysis, transparency and accountability defined structural relationships and well-defined procurement processes were significantly related to budget while the rest of the independent variables pointed to insignificance (p-values >0.05). Unstandardized coefficient values of 0.509, 0.397, and 0.305 reflect the amount of improvement in the dependent variable that will be achieved with a unit increase in the respective significant latent independent variables, provided the rest of the variables remained unchanged. The model recommends that only significant independent variables should be considered for the model being developed.

Table 6. 38:Model Summary: Correlations Between Institutional Capacity and Project Budget

Model	R	R Square	Adjusted R Square	Std. The error of the Estimate
1	.769	.591	.544	.813

Source: Author (2020)

6.9.4 Correlations Between Institutional Capacity and Project Quality

Table 6.39 shows the presence of a strong positive linear relationship between predictor variables of institutional capacity and quality indicated by the multiple regression coefficients of 0.770 (or 77.0%). The computed Adjusted multiple regression coefficients of 0.547 illustrate 54.7% project quality variability that can be explained by institutional capacity with the remainder 45.3% to be justified by factors other than the ones stated in the study. The relationship involving institutional capacity and project quality is noted to be statistically significant with a p-value of 0.000, suggesting that the regression model is a good fit for the data being analyzed.

Four latent independent variables namely transparency and accountability, outcomes-based performance measurement and management, defined structural relationships and well-defined procurement process showed significant relationships ($p<0.05$). Respective unstandardized coefficient values of the latent independent variables were 0.442, 0.328, 0.383, and 0.316, which signified the amount of quality improvement associated with a unit increase of each variable, provided all other latent independent variables remained unchanged. Those variables with insignificant relationships were considered incapable of predicting quality and were therefore not taken to be part of the model being developed (their p-values > 0.05).

Table 6. 39: Model Summary: Correlations Between Institutional Capacity and Project Quality

Model	R	R Square	Adjusted R Square	Std. The error of the Estimate
1	.770	.594	.547	.791

Source: Author (2020)

6.9.5 Correlations Between Institutional Capacity and Satisfaction of Stakeholders

The model summary table 6.40 reflects a positive linear correlation between predictor variables of institutional capacity and stakeholder satisfaction with R = 0.744 (or74.4%). The Adjusted R Square value of 0.504 showed that 50.4% of the variability in stakeholder satisfaction was accounted for by institutional capacity with a remainder of 49.6% being explained by factors other than the ones mentioned in this study. The relationship between institutional capacity and stakeholder satisfaction was seen to be statistically significant (with a p-value = 0.000), meaning that the regression model is a good fit for the data being considered.

Further analyses of the findings revealed that besides transparency and accountability and defined structural relationships, all institutional capacity latent variables considered in the study could not express significant relationships ($p<0.05$). Those variables with insignificant relationships (having their p-values greater than 0.05) were thus not considered in the development of the model, are not good predictors of stakeholder satisfaction. Results also showed unstandardized coefficient values of 0.448 and 0.336 for transparency and accountability and defined structural relationships respectively. The unstandardized coefficient values showed that unit increases in transparency and accountability and defined structural relationships could improve stakeholder satisfaction by 0.448 and 0.336 respectively, provided other latent independent variables remain constant.

Table 6. 40 : Model Summary: Correlations Between Institutional Capacity and Satisfaction of Stakeholders

Model	R	R Square	Adjusted R Square	Std. The error of the Estimate
1	.744	.554	.504	.849

Source: Author (2020)

6.10 Private Party Appraisal and Due Diligence (PPADD)

6.10.1 Correlations Between Private Party Appraisal and Due Diligence And Project Scope

The model summary table 6.41 shows a moderate positive linear multiple correlation coefficient value of 0.673 (or 67.3%) between Private Party Appraisal and Due Diligence (PPADD) and project scope. An adjusted R Square value of 0.391 indicated that about 39.0% of project scope variability was explained by PPADD with the remainder 60.9% being explained by other factors not stipulated in the study. Study results also showed that the relationship between project scope and PPADD was statistically significant with a p-value of 0.000. This relationship implied that the regression model is a good fit for the data being analyzed.

Further analyses revealed that project scope varied with the independent variables (financial capacity and organizational cultures were receptive to the partnership) provided all other independent variables were held constant as elucidated by p-values of less than 0.05. Further, unstandardized coefficient values illustrated that unit increases in financial capacity and organizational culture receptiveness to the partnership could create a positive bearing on the project scope of 0.411 and 0.619 respectively. All the variables with insignificant relationships were not used as good predictors of accurate project scope, having p-values great.

Table 6. 41: Model Summary: Correlations Between Private Party Appraisal and Due Diligence and Project Scope

Model	R	R Square	Adjusted R Square	Std.The error of the Estimate
1	0673	.453	.391	.967

6.10.3 Correlations Between Private Party Appraisal and Due Diligence And Project Budget

The model summary table 6.42 indicates that there is a strong positive linear correlation between predictor variables of PPADD and project budget with R = 0.747 (74.7%). The value of computed Adjusted R Square = 0.508 indicates that 50.8% of project budget variability can be explained by PPADD whereas the remainder 49.2% may be attributed to factors other than the ones mentioned in the study. The relationship between PPADD and the project budget was statistically significant with a p-value of 0.000, implying that the regression model was a good fit for the data being evaluated.

Apart from financial capacity and organizational culture receptiveness to partnerships, the rest of latent variables of PPADD did not express significant association ($p<0.05$), hence they were not to be part of the model is formulated as a result of their minor contribution. The unstandardized coefficient values of 0.608 and 0.626 indicated that a unit increase in independent latent variables of financial capacity and organizational culture receptiveness to partnerships can lead to improvements of 0.608 and 0.626 on the project budget accuracy respectively. However, this can only be possible if the rest of the latent independent variables remain unaffected.

Table 6. 42:Model Summary: Correlations Between Private Party Appraisal and Due Diligence and Project Budget

Model	R	R Square	Adjusted R Square	Std. The error of the Estimate
1	.747	.558	.508	.845

Source: Author (2020)

6.10.4 Correlations Between Private Party Appraisal and Due Diligence And Project Quality

From table 6.43, R = 0.731 (or 73.1%) represents a positive linear correlation between PPADD and project budget. The calculated value of Adjusted R Square of 0.482) shows that 48.2% of project budget variability can be explained by PPADD with the balance of 51.8% being explained by other latent independent variables besides those mentioned in the study. The study results also indicate that latent independent variables and the dependent variable related to each other in a statistically significant way with a p-value of 0.000. This signifies that the model is a good fit for the data being analyzed.

Further results showed that project quality varies in line with financial capacity and organizational culture receptiveness to the partnerships) by way of keeping other independent variables constant. The unstandardized coefficient values designated that a unit improvement in financial capacity organizational culture receptiveness to the partnerships can lead to an improvement in the project quality by 0.574 and 0.571 respectively. Other than these two variables, the rest of the latent independent variables cannot be used to predict project quality (having their p-values greater than 0.05); and hence their exclusion from the model is formulated.

Table 6. 43: Model Summary: Correlations Between Private Party Appraisal and Due Diligence And Quality

Model	R	R Square	Adjusted R Square	Std. The error of the Estimate
1	.731	.535	.482	.847

Source: Author (2020)

6.10.5 Correlations Between Private Party Appraisal and Due Diligence And Satisfaction of Stakeholder

In the output table 6.44, R = 0.722 (or 72.2%) represents a positive linear correlation between PADD and stakeholder satisfaction. An Adjusted R Square value of 0.468 indicates that 46.8% of the variability in stakeholder satisfaction can be justified by PADD leaving 53.2% to be explained by factors other than the ones stated in the study. The study also reveals the presence of a statistically significant relationship between PADD and stakeholder satisfaction (with a p-value of 0.000), which signifies that the regression model is a good fit for the data being considered.

Besides financial capacity, organizational culture receptiveness to partnerships, and adequate technical skills, innovations, and managerial capacity, the rest of the latent independent variables failed to show significant relationships ($p<0.05$). Hence, they cannot be considered in the development of the risk management model. The unstandardized coefficient values of 0.587, 0.631, and -0.403 showed that a unit improvement on their respective latent independent variables (Financial capacity, Organizational cultures are receptive to the partnership and Adequate technical skills, Innovations, and managerial capacity) produced 0.587, 0.631, and -0.403 improvement on the stakeholder satisfaction, provided that other latent independent variables remain constant. On the other hand, some independent latent variables cannot be considered to be part of the model as they seem to be not important since their p-values are greater than 0.05.

Table 6. 44:Model Summary: Correlations Between Private Party Appraisal and Due Diligence and Satisfaction of Stakeholder

Model	R	R Square	Adjusted R Square	Std. The error of the Estimate
1	.722	.522	.468	.879

Source: Author (2020)

6.11 Technical Project Proposal Appraisal (TPPA)

6.11.1 Correlations Between Technical Project Proposal Appraisal And Project Scope

From table 6.45 results, the R-value of 0.617 (61.7%) signifies the existence of a moderate positive linear relationship between Technical Project Proposal Appraisal (TPPA) and project scope. The results also indicate an Adjusted multiple correlation coefficient R Square value of 0.310 implying that 31.0% of project scope variability was explained by TPPA leaving the remainder of 69.0% to be explained by other factors not indicated in the study. Additionally, the latent independent variables related to the project scope a statistically significant, having a p-value of 0.000 which is less than the threshold (0.05). This relationship, therefore, suggests that the regression model was a good fit for the data being analyzed.

Analyses of the individual latent independent variables of TPPA illustrate that except for one variable namely integrated risk management - clear and fair risk balance, the other latent independent variables failed to show a significant relationship ($p<0.05$). Thus all variables without significant relationships, being not good predictors of project scope were not included in the development of the model. On the other hand, the unstandardized coefficient values showed that a unit increase in the latent independent variable (integrated risk management - clear and fair risk balance) would lead to an improvement in project scoping by 0.373 provided other latent independent variables remain changed.

Table 6. 45:Model Summary: Correlations Between Technical Project Proposal Appraisal And Project Scope

Model	R	R Square	Adjusted R Square	Std. The error of the Estimate
1	.617	.380	.310	1.029

Source: Author (2020)

6.11.2 Correlations Between Technical Project Proposal Appraisal And Project Completion Time

The output table 6.46 presented above postulates a moderate positive correlation between TPPA and project completion time (indicated by R = 0.607 or 60.7%). However, an Adjusted R Square value of 0.297 signified that TPPA accounted for only less than 30.0% of variations in project completion time, with factors not stated in the study accounting for about 70.0%. The association between TPPA and project completion time was seen to be statistically significant with a p-value of 0.000, suggesting that the regression model was a good fit for the data being examined.

Except for integrated risk management (clear and fair risk balance), other latent variables of TPPA did not show support for a significant relationship (having p values < 0.05), and could hence not be considered for utilization in the proposed model. The unstandardized coefficient value of 0.446 means a unit increase in the integrated risk management (-clear and fair risk balance) variable was capable of improving project completion time by 0.446 on the condition that the other latent independent variables remain constant.

Table 6. 46: Model Summary: Correlations Between Technical Project Proposal Appraisal And Project Completion Time

Model	R	R Square	Adjusted R Square	Std. The error of the Estimate
1	.607	.369	.297	1.029

Source: Author (2020)

6.11.3 Correlations Between Technical Project Proposal Appraisal And Project Budget

There was a moderate positive linear relationship between TPPA variables and dependent project budget as evidenced by an R-value of 0.653 (or 65.3%). However, only about 36.0% of the variability in the project budget was attributed to TPPA whereas 63.9% was due to factors besides the ones mentioned in the study. TPPA is associated with the project budget in a statistically significant way (with a p-value of 0.000), meaning that the regression model was a good fit for the data being considered.

From the analysis of individual latent variables of TPPA, it was apparent that besides integrated risk management (clear and fair risk balance), all other variables did not have statistically significant relationships to project budget (having p values greater than 0.05); and hence their exclusion from the proposed model. The unstandardized coefficient value of 0.406 signified the amount of budget improvement that could result from a unit increase in the integrated risk management (- clear and fair risk balance) variable, provided the rest of the latent independent variables remained unchanged.

Table 6. 47: Model Summary: Correlations Between Technical Project Proposal Appraisal And Project Budget

Model	R	R Square	Adjusted R Square	Std. The error of the Estimate
1	.653	.426	.361	.963

Source: Author (2020)

6.11.4 Correlations Between Technical Project Proposal Appraisal And Project Quality

The relationship between TPPA variables and the dependent variable (project quality) was positive and moderately strong as evidenced by an R-value of 0.656. Conversely, the adjusted R square of 0. 366 showed TPPA variables only explained 36.6% of the variation in the project quality with the remaining 63.4% being explained by other variables not part of the study. With a p-value of

0.000, the relationship between latent independent variables and the dependent variable was statistically significant, and thus the model was a good fit for the data being analyzed.

Further analysis, indicates the presence of association for the dependent variable (project quality) and independent variables (Fully understanding the business at hand, for example, hydropower and integrated risk management - clear and fair risk balance) by way of keeping other latent independent variables constant. The unstandardized coefficients (B) values, 0.215, and 0.405 meant that unit adjustments on latent independent variables (fully understanding the business at hand, for example, hydropower and integrated risk management - clear and fair risk balance) led to improvements in project quality by 0.215, and 0.405.

Table 6. 48 : Model Summary: Correlations Between Technical Project Proposal Appraisal And Project Quality

Model	R	R Square	Adjusted R Square	Std. The error of the Estimate
1	.656	.431	.366	.937

Source: Author (2020)

6.11.5 Correlations Between Technical Project Proposal Appraisal And Satisfaction of Stakeholders

The model summary table 6.49 shows the presence of a moderately strong positive linear correlation between predictor variables of TPPA and the dependent variable (stakeholder satisfaction) indicated by a multiple correlation coefficient value of 0.639 (or 63.9%). The Adjusted R Square value of 0.341 shows that only about 34.0% of the variance in the dependent variable was explained by the TPPA variables with the remaining 65.9% of variation being due to factors other than the ones revealed in the project. The association between TPPA and the satisfaction of stakeholders was statistically significant (with a p-value of 0.000), demonstrating that the regression model was a good fit for the data being considered.

The majority of Technical project proposal appraisal latent independent variables, apart from integrated risk management - clear and fair risk balance cannot be used in the model as they cannot show a significant relationship ($p<0.05$). The unstandardized coefficient value of 0.484 indicates that a unit increase in Technical project proposal appraisal latent independent variable (integrated risk management - clear and fair risk), increases the Satisfaction of stakeholders by 0.484 on the condition that other latent independent variables remain constant. Study results also indicate that the rest of the latent independent variables cannot be used to predict stakeholder satisfaction as they are insignificant (since their p-values are greater than 0.05).

Table 6. 49: Model Summary: Correlations Between Technical Project Proposal Appraisal And Satisfaction of Stakeholders

Model	R	R Square	Adjusted R Square	Std. The error of the Estimate
1	.639	.408	.341	.978

Source: Author (2020)

6.12 Outputs and Outcomes

6.12.1 Analysis of Correlations Between Outputs and Outcomes -Value for Money

The SPSS output table shown as 6.50 postulates a strong positive linear correlation between the predictor variables of project outputs and the dependent variable (Value for Money) with R-value = 0.816 (or 81.6%). Conversely, the Adjusted R Square value 0.635 gives the indication that over 63.0% of variability related to value for money in PPP Hydro Projects was attributed to project outputs (namely satisfaction of stakeholders, on scope, on quality, on budget, on time), while 36.3% was due to factors other than the ones mentioned in this study. The relationship between project outputs and outcome (value for money) on PPP Hydro Projects was observed to be statistically significant (with a p-value of 0.000), signifying that the regression model was a good fit for the data being considered.

Project scope, project time, and project quality had significant relationships with value for money as indicated by p values = 0.000, justifying their inclusion in the proposed model. The unstandardized coefficient values 0.249 (project scope), -1.289 (project time), and 1.600 (project quality) point to the fact that unit improvement in the affected project outputs would increase value for money through optimization of projects by 0.249, -1.289, and 1.600 respectively, but on condition that other latent independent variables remain constant. The other latent independent variables of project outcomes cannot be used to forecast value for money as data shows insignificance (having p-values greater than 0.05); and hence their exclusion from the model being developed.

Table 6. 50: Model Summary: Correlations Between Outputs And Outcome-Value for Money on PPP Hydro Projects

Model	R	R Square	Adjusted R Square	Std. The error of the Estimate
1	.816	.666	.635	.701

Source: Author (2020)

6.12.2 Correlations Between Outputs and Outcome – Sustainability

The model summary table 6.51 shows the presence of a very strong linear correlation between predictor variables of project outputs and the dependent variable (Sustainability on PPP Hydro Projects) with multiple correlation coefficient R (0.829 or 82.9%). The value for Adjusted R Square 0.658 shows 65.8% of sustainability on PPP Hydro Projects variability can be explained by PPP hydro project outputs with the remaining 34.2% to be justified by factors other than the ones mentioned. The association between project outputs and the sustainability of PPP Hydro Projects was observed to be statistically significant with a p-value of 0.000, signifying that the regression model is a good fit for the data being considered.

Besides project scope, the rest of the latent independent variables cannot show a significant association ($p<0.05$) of $p=0.00$ hence they cannot be considered as part of the model. The unstandardized coefficient value of 0.330 implies that a unit growth in project scope will similarly lead to an improvement in Sustainability on PPP Hydro Projects by 0.330 provide all other latent independent variables (project outputs) remain constant. The other latent independent variables cannot be used to forecast value for money as data shows that their p-values are greater than 0.05.

Table 6. 51: Model Summary: Correlations Between Outputs And Outcome- Sustainability on PPP Hydro Projects

Model	R	R Square	Adjusted R Square	Std. The error of the Estimate
1	.829	.687	.658	.656

Source: Author (2020)

6.13 Responses on whether a well-designed Risk Management Framework could contribute to the achievement of Value for Money on PPP hydro projects.

Figure 6.17 affirms that 38.3% of respondents strongly agreed that a well-designed Risk Management Model can be used to identify and maximize the positive risks that will bring positive opportunities to maximize value for money on a project. The chart also depicts that about 31.7% expressed satisfaction that a well-designed risk management model can lead to increased monetary benefits, followed by 16.7% who could neither agree nor disagree with the statement. On the other hand, 8.3% and 5% disagreed and strongly disagreed with the statement respectively.

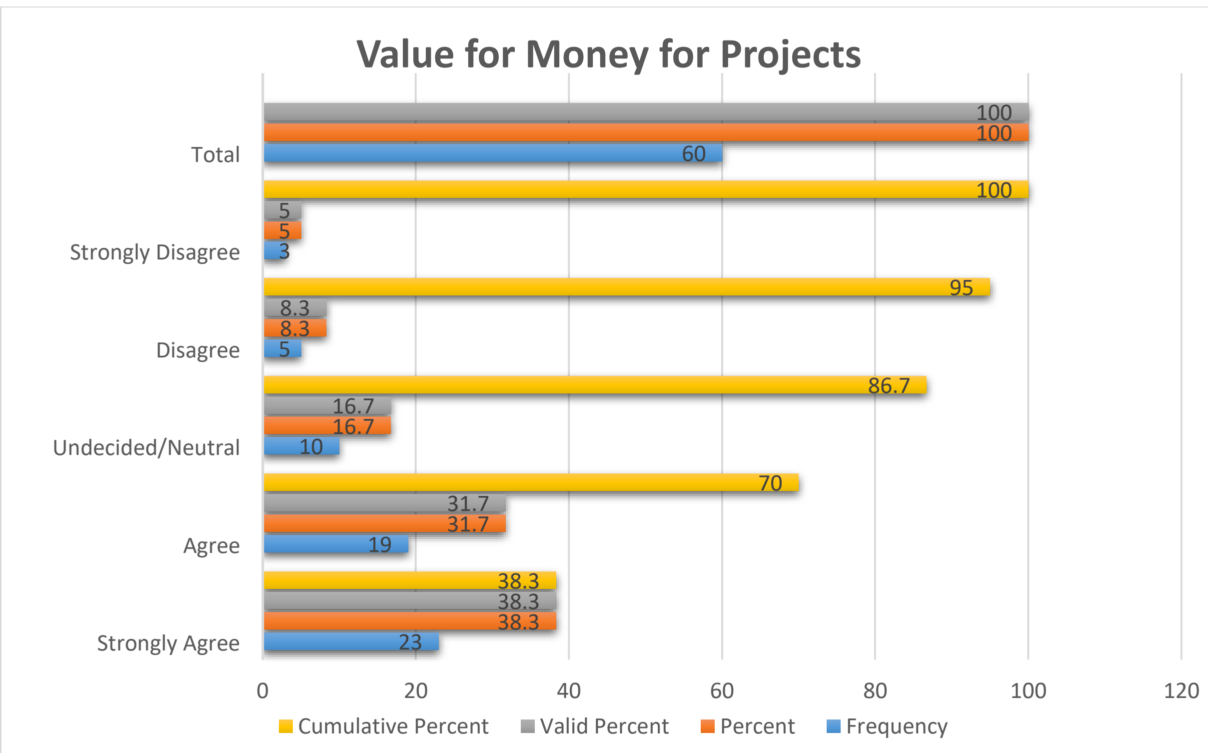

Figure 6. 17: Value for Money for Projects – Source (Author, 2020)

6.13.1 Responses on whether a well-designed Risk Management Framework can contribute to the attainment of sustainability on PPP hydro projects.

Figure 6.18 shows that 35% of the total respondents strongly agreed that a well-designed Risk Management Model can effectively contribute to the attainment of sustainability on PPP hydro projects. That was also seconded by another 35% of respondents who agreed with the sentiment. About 18.3% could neither agree nor disagree that a well-designed Risk Management Model can contribute to the attainment of sustainability on PPP hydro projects. On a contrary, 6.7% and 5% disagreed and strongly disagreed with the expression respectively.

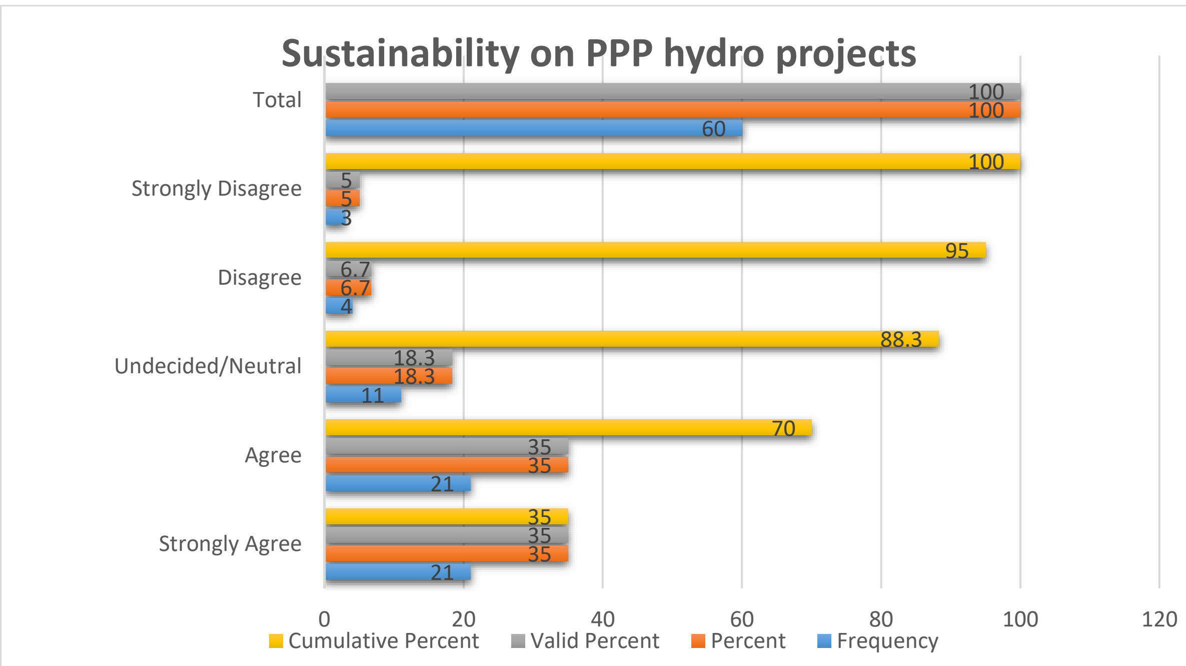

Figure 6. 18: Sustainability of PPP Hydro Projects

6.14 Hypothesis Results

The table above shows the study hypotheses findings summarized concerning the level of correlations between independent and dependent variables. From the multiple correlation coefficient (R) results, both independent and dependent variables have good positive relationships, statistically significant (<0.05) whose p-values are less than 0.05. Multiple correlation coefficient R ranges from 0.607 to 0.985 indicating the presence of a better correlation between the model-independent variables and dependent variables.

Table 6. 52: Hypotheses Test Results After Statistical Testing

Hypotheses	**Yes**	**No**	**R**
	Accept	**Reject**	
H1: There is a significant correlation between SE and project scope	Yes		0.822
H2: There is a significant correlation between SE and project time	Yes		0.985
H3: There is a significant correlation between SE and project budget	Yes		0.965
H4: There is a significant correlation between SE and project quality	Yes		0.968
H5: There is a significant correlation between SE and stakeholder satisfaction	Yes		0.967
H6: There is a significant correlation between IC and project scope	Yes		0.625
H7: There is a significant correlation between IC and project time	Yes		0.828
H8: There is a significant correlation between the IC and the project budget	Yes		0.769
H9: There is a significant correlation between IC and project quality	Yes		0.770
H10: There is a significant correlation between IC and stakeholder satisfaction	Yes		0.744
H11: There is a significant correlation between PPADD and project scope	Yes		0.673
H12: There is a significant correlation between PPADD and project time	es		0.725
H13: There is a significant correlation between PPADD and project budget	Yes		0.747
H14: There is a significant correlation between PPADD and project quality	Yes		0.731
H15: There is a significant correlation between PPADD and stakeholder satisfaction	Yes		0.722
H16: There is a significant correlation between TPPA and project scope	Yes		0.617
H17: There is a significant correlation between TPPA and project time	Yes		0.607
H18: There is a significant correlation between TPPA and project budget	Yes		0.653
H19: There is a significant correlation between TPPA and project quality	Yes		0.656
H20: There is a significant correlation between TPPA and stakeholder satisfaction	Yes		0.639
H21: There is a significant correlation between project outputs and project outcomes (value for money).	Yes		0.816
H22: There is a significant correlation between project outputs and project outcomes (sustainability).	Yes		0.829

Source: Author (2020)

6.15 Responses from Interviews with the Experts

The responses presented below was based on the interview questions presented in this section. Codes were used for easy identification of the respondents and in line with the agreed confidentiality. Thus, the coding was given as Interview PPP/HPP which was shortened as CodePPP/HPP1, Code PPP/HPP2, and Code PPP/HPP 3 up to 15. The sequence followed the same pattern. Out of the target of 15 interviews to be conducted, 8 interviews were successfully conducted representing 53 per cent. Despite, other potential respondents not responding to the invitation, the researcher could not continue with the interviews because there was data saturation.

6.15.1 Interview Questions

a) In your opinion, what are the benefits/drawbacks of a PPP arrangement in hydropower projects?
b) What role does the effective legal and regulatory have in achieving greater levels of sustainable development in PPP projects?
c) Is there adequate integration of Risk Management in HPP/PPP?
d) What is the justification for a well-designed Risk Management framework/model in Energy Infrastructure Development?
e) Is there a very clear rationale for the PPP decision that needs to be supported by a Project Development Stage that includes a Value for Money (VfM) analysis, a Public Sector Comparator (PSC) assessment, and a sustainability analysis?
f) How can PPP hydropower projects integrate climate change?

6.15.2 Benefits and Drawbacks of HPP/PPP

On the question to express an opinion regarding the benefits/drawbacks of hydropower projects finalized through PPP, the respondent's views were as follows;

"the known benefits of PPP procurement model include the development of complex infrastructures by the private sector which proves a challenge if done by the public sector. Also, the private sector brings in a lot of innovative technologies, due to inherent technical expertise. Generally, the execution of the works by the private sector seems easy as they have inventiveness

capacity to reduce the cost of operating or maintaining facilities through the in-depth understanding application of economies of scale and robust procurements arrangements that are more flexible"(Code PPP/HPP1).

Code PPP/HPP2 lamented "the critical component of PPPs is the allocation of the risks to the party with the wealth and capacity to manage them. There is a need to understand that both parties must be willing to take risks that can be managed with little resources. This attributes to the successful delivery of the projects. For example, the permit risks and demand risk must be taken up by the public sector as it has the capacity and influence to mitigate these risks during risk allocation. The project delay and quality of the risks of the work must be managed by the private party while transparency and accountability risks must be shared.

Code PPP/HPP3 and Code PPP/HPP4 mutually agreed spotted out that" PPPs compared to the traditional procurement exhibits high efficiency in the sourcing of project finance and more efficient decision-making process due to the experience and non-availability of the red tape"

"It is not all good with PPPs as mostly the benefits are highly subverted by the unfavourable political and regulatory environment. The legal frameworks in most countries need to be strengthened to mitigate the poor performance of PPP models" Code PPP/HPP1, Code PPP/HPP2, Code PPP/HPP7, and Code PPP/HPP8.

Code PPP/HPP5"One of the most predominant known experiences on PPP is the failure to comply with the contractual terms and conditions. And this causes extreme complications during the execution of the project. Another noted technical issue is that due to the complex nature of the project, it faces unrealistic revenue projections and cost estimates that result in concession failures.

Code PPP/HPP1" PPPs call for the institutional capacity which is highly technically competent. This enables the establishment of strong project management systems that enhance coordination, technical support including checks and balances".

Code PPP/HPP2 & 3 echoes the same similar statement "most PPPs without effective project management system in place, encounters various challenges such as construction delays, delaying *in obtaining land permits, unproven technology, compliance, and regulatory risk and many more risks.*

6.15.3 Importance of Legal and Regulatory Framework surrounding PPP's and Mega Projects Execution

On the question to get respondents to an opinion on the importance of the legal and regulatory framework. The respondent stated that *"PPPs are highly operative in the presence of adequate legal and regulatory frameworks. This is so as the risk allocation becomes very effective, the contract formation is smooth with sufficient laid down measures for enforcing the provisions in an event of any party defaulting". Code PPP/HPP8*

"Concerning the best practices and international standards, there is a need for Governments to overcome several challenges during the implementation of PPPs. And this calls for the development of robust legal and regulatory frameworks. These instruments must be able to give clarity on concessions and the procurement process. "Code PPP/HPP3

Code PPP/HPP 1, 2 &5 "the viability of the mega projects finalized through PPPs must be supported with well-formulated legal systems to enhance the agreements on the duration, quality, and return on investments. Furthermore, there is a high need for political commitment to that in return renders confidence for the stakeholder".

"From my wide experience in PPP implementation, it works well where there is a dedicated public unit under a Government ministry to specifically handle matters related to the same. And this PPP unit which should be supervising all the contract authorities from various government ministries". Code PPP/HPP 4

6.15.4 Integration of Risk Management in HPP/PPP

On the question of the integration of risk management in hydropower projects finalized through Public-Private Partnership, research revealed that "*there is always a traditional way of eliminating the challenges perceived to be a hindrance in the achievement of the project objectives. But, what must be promoted is a systematic technique of identifying the risks, analyze them, and allocate them to the party with resources to manage them". Code PPP/HPP 4*

The research further revealed that "*there have been some situations where the commitment to develop even establishing the system is in place but the reality on the ground has been very unpromising. Thus, it is not just a matter of the documents in place, but there is a need to operationalize the concepts. You need to understand that the integration of risk management must be all-encompassing to ensure it is consistent with the organization's principles and values, strategies, policies, including management control "Code PPP/HPP1.*

Code PPP/HPP4, 6, 8 coincidentally lamented that *"The integration of risk management on projects reduces the poor performance of infrastructure projects. Thus, it should be inculcated from inception project to completion including commissioning. This integrated approach enhances communication, and builds relationships that aid collaboration resulting in reduced project risks".*

Code PPP/HPP 5 reviewed that "there have been some drastic changes in the managing of projects as there is shifting to integrate relevant information and process activities in which risks and response strategies may be identified, analyzed and mitigated in a novel way by the use of database and model management systems. Furthermore, there has been some evidence of Contractors adjusting and showing commitment to integrating risk management strategies.

Code PPP/HPP2 concluded that "ISO 31000 promotes the integration of risk management and corporate governance. It is the best approach for firms undertaking mega construction projects as it ensures that risk management systems are consistent with the organization's principles and strategic plans.

6.15.5 Justification for Risk Management Framework on HPP/PPP

The question to do with justification for a risk management framework the responses were as:

Code PPP/HPP1 recapped that "a well-designed risk management framework must be incorporated in the in hydroelectric projects. This enhances the achievement of the hydroelectric project in terms of time, cost, quality, safety, and environmental sustainability".

Code PPP/HPP3 "Hydropower projects are vulnerable to natural disasters exacerbated by climate change. Thus, the best practice is to ensure there is the effective integration of the risk management framework in hydropower projects "

Code PPP/HPP7 "Some challenges encountered on many PPP projects is that this phenomenon is not fully understood by many Contracting Authority and other government agencies. This affects the development of the risk frameworks as some hidden risks get to affect the implementation stage".

Code PPP/HPP4 "Project financing institutions demand a well elaborative risk management framework as it contributes to the investment returns. This framework forms part of the bankable documents used for the solicitation of project capital"

"Setting objectives is the cornerstone of projects since there must be executed within the cost, quality, and time. However, it is not easy to achieve these objectives due to various risks which eminent from both internal and external sources. This justifies the importance of the risk management framework to manage these risks". Code PPP/HPP 8

6.15.6 Rationale applied in PPP Decision Making

On the question to find out the rationale applied in deciding for PPP in hydropower projects? The research revealed that "*Assessment of Value for Money (VfM) is mostly used when coming up with a decision to use a PPP procurement model. It calls for the typical integration of both qualitative and quantitative approaches in determining whether a project's expected benefits offset its expected costs. The quantitative aspect shows the discounts estimated lifecycle project costs under a PPP versus traditional procurement schemes models. It then presents the respective project costs in Net Present Value (NPV) terms. Upon this analysis, it is then deduced that VfM is aligned project if the lifecycle costs of a project under the PPP procurement model is lower than those of a similar project procured under a traditional procurement method". Code PPP/HPP2*

Code PPP/HPP6 "The Project must be able to meet overall tests of economic value. Also, the hosting Government needs to have stipulated objectives. Further, there is a need to ascertain the skills of the private sector. And finally, the presence of an effective risk management framework *or model is being come a prerequisite for qualifying PPPs especially on huge construction projects."*

Code PPP/HPP1 contested that "The use of VfM assessment in the PPP decision-making sometimes proves to be difficult and contentious. Due to limited ex-post VfM information including HPP/PPP project experience, financial evaluators encounter some significant procedural challenges. There is a need to ensure that the Quantitative approaches to VfM analysis are incorporated with risk analysis. Also, it could be improved significantly with robustness in the systematic collection of data on actual HPP/PPP projects. Establishing what caused the failure of some previous projects could be the best input into coming up with the rationale. Once, this is integrated then the certainty to achieve sustainability is assured".

Code PPP/HPP5 "the gigantic technical potential, and a deep understanding of the best practices in HPP/PPP must be one of the critical rationales. The design of the hydropower Infrastructure design needs to be highly based on quality hydrological data to enhance performance and water management benefits. This is my understanding contributes to the attainment of Value for Money"

Code PPP/HPP2 "project financing aspect plays a pivotal role before embarking on the hydropower infrastructure projects. Developing nations like Zambia with a huge debt of almost USD 11.2billion face a great challenge to attract debt and equity for project financing. So this aspect must be highly considered so that a better procurement model is adopted. This is the main reason the PPP procurement model is highly well-thought-out. But there for the private sector to come on board and express interest in these megaprojects, better institutional policies and regulatory framework must be in place. The other attribute is innovative financial structures that support HPP/PPP. And in this case, some government relies on the use of Public Sector Comparator (PSC). This is an assumed framework used as a strategic benchmark in procurement to assess the evaluating of Value for Money. The salient issue with PSC is that; it does some forecast *and calculation of the net present value basing it on life cycle costing. It also looks at risk management by the public sector if the project was to be delivered by them. The whole justification for the application of PSC is to assist the Contracting Authority in deciding to validate if a private investment proposal offers better VFM in comparison with the most efficient form of public procurement".*

6.15.7Integration of Climate Change on HPP/PPP

On the question of whether stakeholders' have embraced the integration of climate change in the finalization of HPP/PPP? The research revealed that "*Availability abundance water sources as the main component of hydropower projects must be proficiently managed to enhance generation capacity. However, this is not an easy task due to the climate change risk. Climate change risk gets dynamic and very challenging to mitigate. The reason attributed to this is because even if historical data is available, it is proving to be less reliable as the previous information is getting to be a poor predictor of the future as climate change is not constant. The problem with this risk is that it affects hydrology stability and parameters set for the initial designs". Code PPP/HPP8*

Code PPP/HPP 6 "Hydropower being renewable energy contributes greatly to the avoidance of greenhouse gas (GHG) emissions including the mitigation of global warming. Thus, it plays a critical and unique role in climate change. This is one of the reasons HPP is highly encouraged as the source of power in geographical areas that have abundant water sources and favourable topography."

Code PPP/HPP3 "Despite the power generation role of Hydropower projects, water dams have been used as a financing instrument for multipurpose reservoirs that include as an adaptive measure regarding the climate change impacts on water resources. The scientific reasons for the same are that the regulated basins with large reservoir capacities (water dams) are more resilient to water resource changes. This enables them to be less vulnerable to climate change as it acts as a storage buffer".

Code PPP/HPP1 "The Kariba Dam Rehabilitation which is a Project Multinational between Zambia and Zimbabwe was classified as Category 1 by the World Bank's Climate Safeguards System. The bank recommends effective integration systems that adopt monitoring and evaluation of the Zambezi River Basin. Thus, the communities and dam operators must apprehend clearly whether current water management practices are climate-smart. The stakeholders must embrace some major shifts in critical thinking, planning, and designing water investments for the future. The same approach (Climate –Smart Investment) is being considered for the design, construction, and operation of the Batoka Gorge dam. From the records I have read is that during the design of *the Kariba Dam, the likelihood of climate change was not considered. This entails that the reliability of this scheme was therefore expected to be standing. However, from the current literature survey and empirical evidence, reliability is slowly being affected. That is the reason I sincerely agree that having a well-designed risk management model at the project development stage is cardinal for HPP/PPP. At this stage, once risks are identified (i.e Climate Change) can be mitigated by integrating relevant techniques in the engineering design. The best practice is to modify the design by enlarging the capacity of the reservoir by ensuring that a high-reliability level is preserved regardless of any climate change conditions".*

Code PPP/HPP 4 "Many countries including Zambia in the Sub Saharan African region has experienced progressively undependable rainfall outlines with lengthy droughts in the past two decades due to climate change. This has highly affected hydropower generation resulting in a prolonged power outage. And the environmentalist is concerned as this has led to increased dependence on expensive, fossil fuel-based generation. So, it can be deduced that climate change is real and it calls for the prudent engineering design of the facilities to integrate flexible and climate-resilient generation facilities".

Code PPP/HPP 2 "Throughout the project life cycle, there is a risk of natural disasters affecting the infrastructure projects. With climate change, new challenges are being encountered especially when dealing with PPP projects. As PPPs are long-term contracts, the uncertainty levels are very high. This calls for extra effort in the risk management of HPP throughout the project life cycle. This aspect must be addressed at the project development stage to avoid any future problems. The public sector tends to lose more whenever the project fails due to climate changes Private partners demand compensation from the public sector. And this gives a head-up for contractual agreements to ensure such commendation clauses are stipulated.

6.15 Chapter Summary

The chapter started by presenting the reliability of the data collection tools. Then, the results from Delphi Technique, questionnaires and interviews were outlined and tabulated. The profile for the respondents was given in the first part followed by the results for the identification of the risks, allocation, and analysis. Thereafter, the chapter presented the results of the technical inputs and the hypothesis.

The third component of the session provided the responses collected from the interviewees with quotes on various areas surrounding the study.

The next chapter presents the data analysis and discussion and proposes the Beta framework/model to manage risk at the HPP/PPP.

CHAPTER SEVEN

DISCUSSION AND ANALYSIS OF RESULTS

7.1 Introduction

This chapter discusses and analyses the empirical research findings presented in chapter five that was obtained from the Delphi Technique, structure questionnaires and interview guilds. The discussion and analysis have been presented into two segments; quantitative and qualitative in line with the adopted convergent/triangulation mixed-method design. Firstly, the data obtained from Delphi Technique and questionnaires to the HPP/PPP experts have been analyzed qualitatively and quantitatively. Secondly, the thematic analysis of qualitative data obtained from the interviews and site visits have been equally discussed and analyzed. The researcher made some effort to relate the results with previous similar studies, some salient correlated literature from chapter two, the research variables, theoretical framework and the research philosophy. This is imperative as the findings are compared with other preceding research work and the existing knowledge gap in similar studies. The discussions have been systematically presented into three sections guided by the research objectives outlined in chapter one.

7.2 Delphi Technique and Questionnaire Survey

This researcher explored and identified various risks associated with hydropower projects finalized through Public-Private Partnership. It looked at the project development stage of the project cycle. Risks were identified, analyzed and allocated to the party with the capacity to manage them. Thereafter, with the help of the developed technical tools, a risk management framework and the register was developed and validated.

7.2.1 Objective 1: To explore the risks associated with Public-Private Partnership pre-Concessions for Hydro Power Projects at Project Development Stage (*Project Feasibility, Planning, and Procurement).*

With the application of the three-round Delphi Technique and literature survey the identified risks, (forty-two risk factors) were clustered into seven broad risk categories namely contractual risks, financial risks, economic risks, political risks, social/environmental risks, regulatory/legal risks, and technical risks. The use of the Delphi technique has been recommended and used on complex construction projects by various scholars((Effah Ernest Ameyaw et al., 2016). It was used by (Ke et al., 2010) on PPP infrastructure projects. Clustering of the risks was in line with Shrestha (2011) on the development of a Risk framework for Public-Private Partnership in high way construction study, who recommended that various risks must be grouped following their causes so that risk groups are free from redundancy. This can also be used as a basis for standardization in research.

7.2.1.1 Technical Risks

a.) Identification

The study reviewed that the technical risks were highest during the planning stage accounting for 56.8% in comparison with 30.8% in the feasibility stage and 12.4% in the procurement stage respectively. At any planning stage of the construction project, there is a lot of documentation and it is at this stage when the project deliverables including all requirements are defined such as cost, quality and time. Engineers, Contractors and Consultants with extensive experience in planning and construction of hydro-power projects carry out a lot of costing and scheduling estimations. There is extensive integration of all relevant technical data which is collected during the feasibility stage about the power demand, market dynamics in comparison to other energy sources, hydrology, geology, topography, environment and socio-economy. A lot of planning is done in the establishing of the main methodological parameters for the hydro project that includes flow, head and environmental constraints. With derived continuous revisions and defining of the factors during the planning process yields, the establishment of tentative parameters suitable for the construction and unsuitable options are discarded. Also, further assessment of the economic viability of the projects is carried out at this stage. Thus, it is at this planning stage that a lot of inherent risks are encountered.

Incompetent project team members were one of the most significant risks among the individual risks which were clustered in all the project development stages accounting for 19.5% of all technical risks. Batool & Abbas (2017) cited the same risk for the reasons for the delay in selected hydropower projects in Khyber Pakhtunkhwa (KPK), Pakistan. According to Wilhelm (2009), the project design and planning development process for the PPP infrastructure projects in Vietnam was poorly executed due to compromised feasibility study data by some Vietnamese government officials. Okonkwo & Okolo(2014), asserts that the absence of technical and managerial expertise including incompetent team members hinders effective enactment of the public-private partnership project.

The other salient risk is unproven engineering techniques which accounted for 10.7% at the planning stage. This refers to the adoption of immature techniques that cannot realise the standards and requirements as expected. This risk was equally identified to be prominent by Li & Zou(2014), during the assessment of PPP Infrastructure Projects using Fuzzy Analytical Hierarchy Process and Life-Cycle Methodology and Xiong(2017) similarly identified this risk on the two pieces of research titled "VFM and Risk Allocation Models in Construction PPP Projects and Ex Post Risk Management in PPP Infrastructure Projects" respectively.

Lumbroso et al. (2014) endorse that hydropower projects consist of a bundle of technical, environmental and social measures which becomes prone to significant technical risks. Associates (2017), affirms that Public-Private Partnership hydro infrastructure development is inherently complex both technically and financially which makes so prone to several risks. Thus, at the planning stage, the planning engineers and consultants must possess high technical and strong multi-tasking abilities, sturdy analytical, critical and logical intellectual skills, prudent understanding of contract management, sound empathetic of safety protocols and effective stakeholder engagement to minimize or eliminate high technical risks. The Stakeholder Theory plays a pivotal role as it enables bring in on project various skills and expertise to enhance project success.

b.) Risk Allocation

The survey revealed that private entities had a higher allocation of technical risks (46.6%) than public entities (13.5%). On the other hand, the proportion of the equally shared risk (39.9%) is almost as high as that allocated to the private entities. Allocation of specific risks indicated that incompetent project and residual value (after concession period) risks were the highest-ranked risks accounting for 15.3% each. The risk of asset expropriation was the highest risk attributed to private entities (13%) including the risk of unproven engineering techniques (10.2%). While the public sector had risk residual value (after concessions) as the most dominant technical risk factor.

From the study results, the private party was allocated more risks compared to the percentage allocated to the public party and equal sharing between the parties (public & private). This is in line with various research PPP projects. The among other reasons why the public sector considers partnering with the private sector is the leverage of technology and outcome specifications with service standards to be provided, quality control, suitable performance measures and monitoring systems and the project identification abilities including structuring. It this on this premise that more technical risks must be allocated to the private sector as there is the capacity to handle them. This is in line with (Demirag et al., 2012), who recommended that all technical and project-related risks must be allocated to the private sector. Furthermore, (Yong, 2010), advises that to attain the benefits of PPP, is ensure that the risks are allocated to the party who can best manage it. And in this case, the technical risks are best managed by the private party.

The results reflecting a high percentage of risk-sharing between the public and private sector on an HPP/PPP are also similar to the study which looked at risk-sharing and investment appraisal for PPP Procurement Success in Large Green Projects(Almarri & Blackwell, 2014). The study recommended that to mitigate the unexpected events on the PPP projects, there should be effective `negotiations of the identified risks by aligning them to the project objective and balance the impartialities of risk-sharing between public and private parties. The appropriate alignment of sharing of risks on a PPP project is premised as among the high contributors to the achievement of Value for Money as stated by (Demy Chung, 2012).

This study has revealed that the fundamental principle of sharing is to balance the risks so that both the public and private sectors benefit. Furthermore, from the trend of this research's results and literature survey conducted(Kachapulula-Mudenda et al., 2019), this author deduces that the private partners are more competent to manage the risks associated with the project directly (meso risks) while most macro-level risks such as political, legal, social and economic risks which are "exogenous" to the project are mostly borne by the public. The ability to influence the risk factor and mitigate it is the key principle on risk allocation, and correspondingly mitigate/absorb the risk to the greatest extent possible.

7.2.1.2 Contractual Risks

a.) Risk Identification

It was revealed from the survey that in the development process of Hydro-power projects, the largest proportion of contractual risks came to the fore during the planning stage while the risk was lowest in the feasibility stage. Almost 38% of all contractual risks occurred in the planning stage, 35.1% occurred during the procurement stage and 27% occurred in the feasibility stage. The contractual risks proved to be more at the planning stage as this is one of the most critical project phases that involve the creation of a set of plans that guides throughout the project life cycle. The set of plans enhances the management of time, cost and quality. Thus, the contractors, consultants and project sponsors at the planning stage, are highly expected to have taken reconnaissance of the site, analyse the geological and hydrological conditions and factor in the contractual price based on the perceived risks. Once, the contract is signed, any loss and expense claims that could have been incorporated in the sets of plans cannot be reimbursed. The reimbursement can only occur if it is established that the sustaining variations were beyond the expectations of an experienced and diligent contractor during tendering. These risks have got a high probability of occurrence and the impact could constrain the ability of the contractor to achieve the project objectives.

Besides, Mbachu & Taylor (2014) corroborates that the planning stage is prone to contractual risks and if not managed well, it presents as the main causes of insolvency, liquidation and bankruptcies of contractors. Andrade & Loiola(2013), further hints the high contractual risks at the PPP formulation stage could be attributed to the high level of bureaucracy in the public sector decision-making process including lack of distinction between practice guidance and restrictive regulation. This combination leads to extreme standardization in contractual clauses and conditions that encumber the PPP design and planning process.

Further results indicated that risks emanating from faults in the tender specification (22%) were the most common contractual risks faced in all the project development stages, followed by accountability/transparency risks (14.1%). At the tendering stage, various documents are involved in form of Drawings, Technical specifications, Scope of Work, Bill of Quantity (BOQ), Safety, Healthy, Environment and Quality (SHEQ) Procedures and any other documents within the battery limits. It is from this precedent that inherent risks at this process are eminent. Any mistake or poor preparation of these documents causes further challenges in the proceeding project life cycle stages. This study's results correlate with (Yuni et al., 2017) whose findings were that many challenges faced by the mega construction projects in Bali Province, Indonesia was intensified by defects and incompleteness of documents on tender dossiers at the project planning stage. Medda (2007), agrees that prominent risks at the project planning and procurement stage on PPP projects defect design of the tender specification or contractor design fault. Due to the complex nature of hydropower projects finalized through PPP, the tendering process is prone to a lot of risks borne from the input data. This can consist of untested technical innovations which are specified in the tender documents. Secondly, some existing technology on a certain project is proposed to be superimposed on the new project site. Last but not the least, the deficient engineering and design work in the project planning stage could results into risks at the subsequent project life cycle stage such a systems compatibility, performance expectations and demand risk.

Accountability and transparency risks were the second prominent among the contractual risks. The transparency environment at the project development stage is very fundamental as it is at this stage when the project appraisal, selection of the best bidder, design and budgeting is carried out. It calls for legal responsibility to reverence the legitimate interests of stakeholders affected by decisions made and any interventions. Mega hydropower projects to be finalized through PPP are being highly considered in the developing nations in cost-effectively addressing desperate infrastructure needs for the public sector. Despite, the complexity of these projects and transactions involved, the public sector lacks requisite expertise, institution capacity, transparency and accountability in public-private partnerships with the potential to undermine democratic governance. This ultimately leads to increased corruption, political interference, room for exploitative foreign powers, and undermining the public faith in governing institutions. These findings on these risks are similar to what (Daniella Nel, 2013), established in a study that looked at risk governance in public-private partnerships. Farlam(2005), while assessing PPP in Africa recommended the need for implementing the transparency and accountability mechanisms at the project stage of PPP projects. This author deduces that misdemeanours at this initial phase provide the bedrock for corruption at subsequent project stages. Transaction Cost Theory and Contract Incompleteness fits well on contractual risks.

b.) Risk Allocation

The study showed that most of the contractual risks were equally shared between public and private entities. However, the public entities had a higher individual allocation compared with private entities. 54.0% of contractual risks were equally shared, 24.8% were allocated to public entities and 21.2% were taken up by private entities. These findings relate to what (Hillson & Hulett, 2004) established that the Public sector must not only be transferring all the risks to the private sector, but also build capacity to retain some risks. From the extensive literature survey conducted on this study, it has been observed that there is some realization that the private sector is unable to engross limitless risks. Accordingly, the idea of just transferring all the risks to the private sector does not yield the required results as mostly, in the end, the risks are transferred back to the public sector. And this is mostly done at the cost to the taxpayers and the general public. In agreement with this author's analysis, a study that looked at life-cycle risk management framework for PPP infrastructure projects(Zou et al., 2008c), established that PPP entails coming up with an enduring and stable relationship among the stakeholders as it is perceived that each partaker brings something of value to the partnership. Which makes it essential that risks and responsibilities must be shared between parties. And this is underpinned by a contractual framework.

Furthermore, the study revealed that the conflict between partners along with different working methods (know-how between partners) was seen to be the most equally shared contractual risk in Hydro-power public-private partnership projects. Whenever there is a violation or disregard to the agreed terms or conditions, a contract conflict may occur. Conflicts may arise at the earlier stages of the contract formation and can be present as a major risk to further contractual niches in the future. Hughes and Weiss (2007), discovered that despite the increase in partnership on projects, the failure rate is drifting between 60% and 70%. This is mainly attributed to the lack of a solid business plan supported by a good structure contract. So this affirms the reason why these contractual risks are almost equally shared as it borders on the partnership. Hence, in mitigation, these risks (Hughes and Weiss), recommend the proper definition of metrics for assessing the partnership value. Also, during the contract formation, the establishment of formal systems and structures plays a fundamental task in managing these risks. McCann further agrees on the motion of equally sharing the contractual risks by illustrating that the achievement of VfM and sustainability outcomes of the PPPs, partners must equally prudently manage the governance of the contract. Further, explains that though the private partner is expected to deliver agreed performance parameters, the public partner is ultimately responsible for ensuring that these parameters are actualized to meet the standard.

7.2.1.3 Financial Risks

Financial risks facing HPP/PPP were ostensibly the highest in the planning stage of project development accounting for 43.5% of all financial risks in comparison with 30% incurred in the feasibility stage and 26.5% incurred in the procurement stage respectively. The feasibility and planning stage of HPP/PPP takes a lot of time that it becomes prone to various macroeconomic forces and faces distinct high financial risks due to instability. At the planning stage, a lot of financial resources is integrated during the design, development of specifications, modelling so that the project viability is ascertained to mitigate performance deficits during the life of the project. In agreement with this assertion, the International Finance Corporation (IFC) of the World Bank, (2011), confirms that planning of HPP must take into consideration the growing demand for water due to economic development, developing techniques to address conservation goals in case of natural disaster and increased power demands that will need additional water for a generation.

Furthermore, the higher financial risks at the planning stage of HPP are worsened by other stakeholders demand for ensuring that the project has effective incorporation of sustainable livelihood interventions that include management of water, production of livestock, growing of crop varieties and fruit trees, fish farming, increasing market access, and addressing cross-cutting issues such HIV/AIDS, gender and the environment. In all this planning, there is also focusing on climate-smart investments. All these factors come with financial implications. This research's findings of higher financial risks during the planning stage is also in line with (Demirkesen Çakır *et al*., 2015), who stated that unexpected costs might occur during the design of PPP projects.

Additionally, the research established that the risk of cost estimates/ cost overruns and schedule delays and Local currency devaluation. were among the higher risks at the planning stage. At the planning stage, rough estimates of all relevant costs for investment, operation and maintenance costs, commissioning and decommissioning costs for the lifetime of the project are established. There are high risks of not ensuring that the cost estimates are all-inclusive. Many at times, some important cost components such as asset replacement costs, overhead costs for planning and supervision including contingencies may be omitted, but during proceeding project stages, the same costs are encountered. The cost estimate risk also plays to the economic and market dynamics such that the unit prices do not remain the same for a long time. These high-cost estimate risks findings are also similar to those (Kashiwagi & Kashiwagi, 2012), who reviewed that the research which was conducted by the Standish Group showed that 52.7 % of the projects cost two folds (189%) of the original cost estimates. Thus, since cost estimates are well-known risks, the Batoko Gorge Hydro – Electric Scheme project during the planning stage, Ernst and Young (2017) states that a comprehensive financial model was developed with current cost, timing and economic estimates to mitigate the risk. It can be deduced that the planning stage is a critical component that can affect the achievement of the Value for Money in the absence of greater attention on the quality of estimates, experienced financial consultants and transaction advisory teams.

On the schedule delays being among the highest risk, this is in line with the findings done by (Hung & Wang, 2016) on the Engineering Procurement and Contract Management of Hydropower Construction Projects in Vietnam. A further interrogation of this risk by this author it was established that it is caused by either internal or external factors associated with HPP. And this may include; incompetent management practices leading to delays in administrative approvals, land acquisition, and interpretation of geological conditions. These risk factors have got an impact on the financial terms at the planning stage.

The other prominent risk was low liquidity, depicting insufficient funds to carry out the project activities. This could be caused by limited debt and equity on the project. Demirag *et al.*,(2012) urge that to mitigate the risks on mega construction projects liquidity support can be critical on the capital structuring. Likewise,(Helby Petersen, 2011), confirms the impact of liquidity on the financial markets that it increases the cost of the private sector accessing project finances leading to more money expensive than previous finalized PPPs. This can also affect the perception of PPPs as a solution for private capital investments. The Transaction Cost Theory integrates well on this risk.

b.) Risk Allocation

Private entities had a higher allocation of financial risks in HPP/PPP when compared with public entities. Over 47.9% of the financial risks were allocated to private entities, 37.0% were equally shared and about 19% were allocated to public entities. Effective risk allocation has the potential to improve project performances as risks are allocated to the partakers whose risk acceptance is high. The findings of this research are in similarity with Sarmento (2014) who stated that finance risks being economic risks must be allocated to the private sector. However, in support of Sarmento (2014), but with caution, Saiyed (2015), urges that to achieve better value for money during risk allocation, there is a need to exploit the private sector competencies in terms of managerial, technical, innovation and financial over the project‘s lifetime.

Another intellectual debate regarding the findings on this research, Wang (2000) schooled that consideration must be set to understand that traditional public sector borrowing rates are lower than private-sector borrowing rates. Thus, this risk must be borne by the public sector or should be shared by government-guaranteed private sector financing. Cameron, in affirmative, asserts that the public sector in the PPP partnership should also keep some financial risks that can be managed to mitigate the total failure of the projects through the total transfer of all risks to the private partner. The authors continue that most PPP infrastructure projects which failed were attributed to failure to develop prudent financial instruments by relying more on the private sector. The public sector has got the capacity and influence to negotiate better financial instruments than the private sector. However, the issue is that most governments in developing nations have much huge external and domestic debt such that getting back to the financial markets to negotiate for more financing becomes a challenge. Hence, the private sector remains the solution.

On the sharing of the financial risks which came out second on the findings, in-depth interviews with the respondents reviewed that some financial risks must be shared between the parties, although at varying degrees. This entails, there is a need for a combined and dynamic risk plan discussed during the contract negotiation. Since PPP are long terms contracts, the plan must be flexible that can easily be adjusted whenever the economy or market dynamics emerge. Further, revelations during the in-depth interviews with the expert were that some financial risks should be shared by both parties though perceived to be in the dominion of the respective party’s field of expertise. For the success of PPP, both parties must be able to develop sophisticated approaches to manage financial risks as per best practices and the increasing market competition. For instance, liquidity risk may be mitigated by increasing the tariffs by the government.

One of the main objectives of PPP is to achieve Value for Money and sustainability through the best combination of the entire project life costs and its benefits. To accomplish this goal, it is important not to only capitalize on risk transfer on the entire project life cycle, but to optimize risk allocation. Due to the complexity of the PPP projects in mixture with sophisticated project financing risks, the private sector is not able to absorb unlimited and real risks costs. Hillson & Hulett (2004), confirms this assertion by stating that risks must not all be transferred to the private sector because in an event of force majeure, pandemic or any national economic impacts on a project, the private entities may run into financial complications and fail to deliver on the set project objectives. Once this occurs, the public sector usually steps in to take -over the unfinished or underachieving project for public interests.

Thus, it can be reasoned that on some particular risk, the risk transfer is not complete as in the event of extreme project failure, the half-finished project could return to the public authority to handle the project. On the sharing of risks, Davies and Eustice (2005) in line with this author's deduction, some risks cannot be completely transferred where the infrastructure life cycle is beyond the scope of the PPP project life cycle. A. Shrestha et al. (2013) stressed that the provision of the optimum level of incentives by the public sector leads to the achievement of projects objectives. This forms a basis of financial risk-sharing on the contract. These findings are in line with this author's analysis of the flexibility of the contract.

7.2.1.4 Economic Risks

Almost 36.9% of the economic risks associated with HPP/PPP were encountered during the feasibility stage, 33.5% in the planning stage, and 29.6% in the procurement stage. At the feasibility stage, an in-depth analysis of the energy generation cost, investment plans and maintenance costs for HPP are considered. Key processes such as energy supply plans are developed based on the forecasted future power demand. This takes into consideration the capacity of existing power plants and intended projects. The power generation type is decided by considering the impending power demand-and-supply, the topography and the geology of the project site. Upon confirmation of the environmental impact of the project, the optimum development scale is examined comparing the economics of the different maximum outputs and dam heights. Decisions must be effectively and prudently made to strengthen engineering economic risk mitigation.

The accurate estimation of the investment and technical viability of the project is usually done with the aid of econometrics tools to ascertain generation capacity estimation as well as environment protection on various river basins. The feasibility stage for HPP/PPP takes a longer period than the planning and the procurement stage such that it becomes so prone to various economic risks. Thus, this stage is prone to higher economic risks. Yankson et al., (2018), stated that the project development stage of the Bui dam in Ghana encountered high social-economic risks which received a lot of opposition from the stakeholders. Kougias et al., (2019), also in line with this research's findings cited the UPHES in Germany faced high economic risks during the feasibility stage.

The single most common economic risk was the level of demand for the project which occurred in the feasibility stage and accounted for 13.4% of all the economic risks. The demand risk factor looked at the potential for a loss caused by a gap between forecast and actual ultimatum. For HPP/PPP, this is principally due to huge capital investments required as when these forecasts are inaccurate it leads to losses or suboptimal performance. Thus, during the feasibility stage, this risk must be adequately mitigated to avoid consequences during the operation stage. Kabanda (2014), confirms this research's findings by illustrating that the Bujagali dam was expected to generate 250 MW capacity in Uganda but could not meet this due to inadequate water to sustain the demand. Another case is Nalubaale and Kiira dams that were expected to meet the demand of which 380 MW but during operations was only able to generate between 110 and 135 MW. This demand risk could have been eliminated or reduced at the feasibility stage by collecting all the technical parameters which must be incorporated at the planning stage.

On the other hand, the interest rate was the most prominent risk across all the three development stages, accounting for 27.6%. Just from feasibility to generation, there are a lot of financing needs that are required for HPP. Thus, the financing from promoters and individual investors, national and foreign Commercial banks, Institutional investors, Capital markets and international financial institutions has become progressively more difficult to secure, making loans and equity capital from the private sector increasingly competitive for the financing for hydroelectric power projects. As HPP requires large up-front investment during the project development stage, it is often viewed as high risk compared to other power projects. This finding is cemented by Jenssen *et al.*, (2000), who stated that the economic life of a hydropower project is very long for the amortization of the loan. For instance, for a large HPP, the feasibility study generally ranges from 1 – 2 % of total costs, while for a small HPP it goes up to 50 % of the cost according to Breeze (1997) as the economic feasibility of these projects are very cost-sensitive that leads to tight cost control. Thus, the lending institutions leverage this risk by imposing high interest rates at the project development stage. This conclusion is supported by Md Lasa *et al.*, (2018), who stated that the high risks during the early stages of HPP/PPP ground the bank to impose a high interest rate.

However, Ehlers (2014) in the study "Understanding the challenges for infrastructure finance" recommended that these high-interest rates can be negotiated by ensuring that projects are properly planned, designed, making them investable complemented with well converted contractual arrangements with equitable distribution of risks.

7.2.1.5 Political Risks

a.) Risk Identification

The largest proportion of political risks were encountered during the procurement stage with the risks being substantially lower during the planning stage. Approximately 38.1% of political risks were faced during the procurement stage in comparison with 37% and 34.9% faced during the feasibility and planning stage respectively. These risks affect the investment's returns due to changes or instability of the nation especially on complex and longtime investments projects such as hydropower. The HPP/PPP investment's returns could be affected due to political vicissitudes or country instability. And this becomes more of a factor since the time horizon of investment gets elongated.

Sovacool & Walter (2019), revealed similar assertions by stating that despite the conceivable benefits of better-quality energy access, social-economic development and positive spillover effects from the HPP, there are some constraints in full recording success due to the involvement of multiple political actors with competing customs operating athwart multiple scalar levels. WEF(2015), echoes the same sentiments by enlightening that political risk is viewed by investors as the greatest deterrent for any huge investments into emerging markets, more than macroeconomic instability. The significant risk factors such as a change in law, delay in the approval of the project, permit delays, public opposition and poor regulatory framework affects the success of HPP/PPP. A well-designed legal/regulatory framework plays a vital role in the investment of infrastructure development. However, the investor's concerns are the unexpected change of the regulation and statutory requirements as it possesses as the political risk factor.

Since HPP/PPP investments typically involve a long asset lifetime and complex contractual relationship, mostly the return on investments is well beyond the term of any individual government. The change in political administration comes with a lot of complications that can drastically affect the PPP agreements. This attributes to the reasons why the financing institutions, project developers and cooperating partners become so much risk-averse. The stakeholders advocate is that there are assurance and commitment of the agreed parameters not only by the present government but also the future governments to secure the investments. Lau Siew Soon (2012), confirms this assertion by explaining that there is the existence of political intervention with the public sector. And this is usually common when there is a change of leadership in the sector that can influence decision-making.

Political risk findings at the planning stage, are similar to a study on renewable energy sources in power generation in Pakistan Shakeel *et al.,* (2016), the project did not yield the expected results due to poor planning exacerbated by poor policymaking, lack of foresightedness, ineffective management and corruption. The political risks over warmed the planning stage. The research reviewed that the planning stage possesses significant political risks as it is one of the prominent stages which requires a lot of detailed integration of many factors for the success of the project. Since, HPP relies on water, rivalry over limited water resources with the surrounding communities proves a challenge during planning as a lot of consideration must be taken. Rigidities regarding freshwater management lead to exacerbating existing tensions, increase regional instability on transboundary water resources and social unrest. Farinosi *et al.*, (2018), findings strengthen this author's analysis by stating that the amalgamation of climate changes and increase in population dynamics is anticipated to impact negatively on the overall hydro-political risk. This is expected as it calls for more water interactions in the transboundary river basins resulting in tensions. Accordingly, the designing and planning of HPP must incorporate the population density, availability of water (Falkenmark index), upstream and downstream dynamics by considering the flow accumulation, territories and climatic conditions. While damming upstream, many downstream rivers are dying without flowing enough water in the dry season.

The feasibility stage is second in terms of high political risks as stated by the results.HPP/PPP being large and complex. This is a vital stage as it is carried out with the view of confirming site desirability, development of a preliminary plant design, understanding the impact of the project on the environment, investment requirements estimates, understanding the legal and regulatory framework and preparing the project for financing. Now, these activities are prone to high political interference, public opposition and inadequate distribution of authority between partners. Zou *et al.*, (2017), confirms high risks at the feasibility stage of mega construction projects urges that clients, project designers and government bodies work obligingly from the feasibility phase onwards to address political support, public support including a clear project brief. The high political interference at the feasibility stage was also cited by (Keane & Keane, 2018) in the study regarding Infrastructure Development through PPP. Several failed PPP projects in Pakistan were worsened by low-quality feasibility studies influenced by various political risks (K. M. Mazher et al., 2017).

The feasibility stage forms part of critical success factors of HPP/PPP success, thus project stakeholders must be able to devise technical innovation and a mechanism of handling the political risks. As there are a lot of interest groups ranging from environmentalists, governments, communities, it is imperative that for the sustainability of these projects, better recognition of stakeholder's perception, compensation and economic and sociopolitical dilemmas. Project designers and planners must highly consider the underlying assumptions and expectations of all players. For political interference being high at the feasibility stage and some subsequent project life cycle, the political economy of HPP is also about continuously managing a series of malevolent risks.

The procurement stage had the highest risks according to the findings. The interference of some governments in the procurement process has been cited in many studies (Eurodad, 2018; Powanga, 2019). The predominant role played by large foreign contractors usually results in political situations with the local contractors who plays a vital role as domestic suppliers, contractors and consultants under sub-contracting arrangements. Though the procurement stage of mage construction projects is equally involved with a lot of monitoring by various security agencies and other mechanisms to minimize or eliminate the political risks, some governments manage to influence the process in the name of sovereignty. The finding by this study of the HPP/PPP having a high risk at the procurement stage is similar to (Michael & Bengesi, n.d.), who stated that there is a lot of corruption among some public officials. Also, the author reveals that the private sector does not trust the reliability of the public sector on the commitments and obligations of the PPP procurement guidelines.

Nevertheless, a senior expert revealed that when the financing of the project is done by some strict international financing institutions, a lot of due diligence is is demanded before the selection of the contractor, supplier and consultant to create value as well as cut costs for the project. There is an assurance that the procurement process is impartial, well-organized, translucent, answerable, and ethical and contracts are done on opportune. This finding is in line with (Kavishe, 2018), who explained that the PPP model contributes greatly to the reduction of project risks as compared to traditional procurement due to effective risk management processes demanded by the stakeholders. The Stakeholder Theory and Transaction Cost Theory covers the illumination of this risk.

b.) Risk Allocation

The allocation of political risks to private entities was substantially smaller in contrast to either public entities or equally shared arrangements. 19.1% of political risks were equally shared, 68%

were specifically allocated to public entities and only 12.9% were exclusively allotted to private entities.

The findings showed that the public sector was allocated more risks than private entities due to their inherent governance of enacting and enforcing appropriate legal and regulatory frameworks for investment. The model situation is that the specific regulation and statutory requirements of each infrastructure sector should be robust, and flexible to suit the prevailing economic situation. The assertions on the suitable legal framework on huge investment are echoed by Zou *et al.*, (2008b), with the agreement that the uncertainty of public sector policies and change of government administration are the causes of political risks. Reside (2008), agrees that the public sector possesses the prerogative for any legal and regulatory changes that can drastically affect and undermine a project's market value. This marks part of the reasons why the political risk is allocated to the public sector as the stakeholders do realize that these particular risks should be retained and co-opted within the public sector.

The high percentage of political risks to the public sector as per this research results alluded to Jakutyte (2012), who illustrated that political risk which includes; Government corruption- this leads to increase the project cost and the relationships between the government and the project SPV; Public sector intervention – affecting the autonomy of private investors' decision making; Nationalization/expropriation – seizing of the project by the government authority; and Poor public decision-making process – this is attributed by non-standardized procedures, poor bureaucracy, poor experience in PPP projects by the public officials must be allocated and mitigated by the public sector. Another high percentage showed the equal sharing of political risks between the private and public entities. The sharing of risks enables that the rewards and losses of participants are allocated within the group basing it on a predetermined formula. It reflects the party's insurance scheme of managing or risk exposure reduction through the spreading the burden of loss among the partners. The sharing of the risks between public and private sectors is carried out through contractual agreements. Yakubu & A. Anigbogu (2016), findings are similar to this author's discussion on the risk-sharing that PPPs are only effective in an enabling environment with adequate legal and regulatory frameworks complimented with a risk-sharing structure which well enshrined in the contractual agreements. The Incompleteness of Contract Theory applies to this scenario.

7.2.1.6 Social/Environmental Risks

a.) Risk Identification

Over 52% of risks were encountered in the feasibility stage, 29% in the planning stage, and 18% in the procurement stage. The feasibility stage being the early stage of HPP is a critical stage on which a lot of assessment on the economic viability of the project including some uncertainty or polemic regarding the proposed development is done. The key study areas that consist of the topography of the area, geological structure of the ground, hydrology quantity, and preparation of bankable documents, project financing and social-environmental surroundings are taken into consideration. The study of these mentioned key components takes a longer period than any other stages on the project development stage of the HPP rendering the stage very risky and costly. For instance, Ojukwu, C., Cheikhrouhou, H., & Kanonda (2013), reports the feasibility study for the Kholombidzo HPP was undertaken from 1985 to 1998 just to confirm the optimal location and layout for the power plant.

These findings are in agreement with (Kucukali, 2011), whose survey results revealed that the site geology and environmental issues were considered as the most important risks at the feasibility stage. Social and Environmental risks classically comprise pollution to the environment, threats to human health, safety and security, Impending conflicts over transboundary waters, both positive and negative bearings on communities and danger to a region's biodiversity including cultural heritage. This is a very delicate and imperative stage as lots of resources are dedicated to applying the step-wise approach so that strategic decisions are made before the commencement of subsequent stages. Thus, any technical errors made at this stage has got a drastic effect on the inputs to the planning, procurement and construction stage.

The planning stage came out second in terms of high social and environmental risks. The engineering and detailed design of HPP must take into consideration all the salient social and environmental aspects analyzed during the feasibility stage. These include; resettlement of the native people, their livelihood, culture and traditions which may be impacted by the dams and reservoirs. The upstream and downstream flow of the river must be integrated into the planning stage. Thus, the project developers get to deal with these basic complications inherent through the transmuting of the natural world into a human environment. It is during the planning of these activities that high risks are encountered which can impact the project objectives.

These factors are inherent in mega construction projects that are the reason practically all transactions are exposed to some level of environmental and social risk. And the industry sector plus the geographic context plays a vital role in the inherent component of this risk. The findings indicated that the most common risks associated with each development stage were land acquisition and compensation problems, market dynamics, and corruption which accounted for 11.8%, 7.6%, and 10.4% respectively. In affirmation of these results, Johnson *et al.*,(2017), states that large-scale infrastructure projects do harm the poor by destroying their inherent social fabric of local cultures, their native biodiversity, and the natural resources on which they depend. There is massive resettlement which negatively affects what their existence depends on. Yankson *et al.*, (2018), confirms this finding by illustrating that during the development of the Bui Dam construction there is an unequal distribution of the benefits attributed by environmental changes while Sino-hydro (Project Developers) and the Bui Power Authority (BPA) had some financial gains. Hake *et al.,(*2016), in the study of the Analysis of Risk Factors in Public-Private Partnership (PPP) Projects, cited also land acquisition and compensation as a high-risk factor.

Corruption, which accounted for approximately 22.0% of the risks, was the most significant social/environmental risk faced during the development stages of hydro-power projects. This vice leads to abuse of the public offices for private gains and in some instances, there is 'state capture 'by the influential private parties. Where there are weak controls aggravated by the poor legal and regulatory framework on PPP models, high levels of corruption alter government decision-making and affecting private investors' decisions. The findings of this research are similar to (Sobják, 2018), whose study revealed that the corruption at the project development stage is very high and it is triggered by poor transparency environment of the project feasibility stage and planning which encompasses project origination, appraisal, selection, design and project budgeting.

b.) Risk Allocation

The survey showed that social/environmental risks were substantially equal shared between project partners, and that risk allocated to individual entities was almost the same. Over 36.5% of the risks were equally shared while 29.7% and 33.8% were exclusively allocated to private and public entities respectively. Once the project is cited for the abrogation of the environmental and social legal requirements, liabilities and constraints are imposed on a project. This may be a very weighty cost that is allocated to the private entity and the cost of compliance can be significant and will need to be allocated between the project company and the contracting authority representing the public sector. Since mega construction projects are usually executed using project financing from private institutions, many stakeholders demand accountability. Institutions such as the International Financing Institutions and other International Cooperating Partners demand that the project meets the minimum social-environmental requirements as per international standards or best practice (Equator Principles). This effort should come from both public and private partners. That gives the impetus for this risk being shared. These findings are similar to (Kakati & Dean, 2016), Optimal Risk Allocation In Public-Private- Partnership (PPP) Projects.

Furthermore, the energy infrastructure development projects have a significant impact on local communities and the quality of livelihood for the inhabitants. This is the reason, non-governmental organizations, environmentalists and community members offer some opposition and undermine the project viability. This leads to project costs due to unnecessary delays. For effective mitigation of this risk, the public sector is in a better position to manage this predicament through political will and certain statutory implementations. The community can listen more to the public sector than to the private sector. However, the private sector must come on board to engage the stakeholders on the positive impact of the project. Hence, both partners must work together to achieve this objective. This is the reason the findings revealed some significant responsibilities which should be shared between the public and private sector with regards to social/environmental risks. Zhang *et al.,* (2019), in affirmation state effective cooperation of the public sector and private sectors could lead to the reduction or elimination of the manifestation of social and environmental risk.

Cultural differences between main stakeholders, which accounted for 12.9% of all social/environmental risks were seen to be the most significant equally shared risk. These findings are similar to (Minnie et al., 2011), who exemplified that despite PPPs facing economic policy challenges, cultural and institutional greatly contribute to the failure of PPP projects. The fundamental cultural difference between the private and public sectors is defined in the rules of operations. The public sector is controlled by the state as it forms part of the economy which consists of various strata of people performing different state roles. For the governance of the state and effective coordinating of various tasks, some rules and regulations are defined for the common good. While the private sector is answerable to their own organization's policies and state laws. The private sector strives to be competitive and ensure there is a return on their investments including profitability. Their goals are aligned with profitability and return on investments while the public sector is service first. It is these opposing organization cultural perceptions and many others that extricate two sectors.

7.2.1.7 Regulatory and Legal Risks

a.) Risk Identification

Most of the regulatory and legal risks were in the planning stages of project development. Almost 46.7% of the risks were seen to be encountered in the planning stage, 32% in the feasibility stage, and 21.3% in the procurement stage. The regulatory and legal framework is a very critical component of a successful PPP as it borders on several factors. This assertion is in agreement with (Ernest E. Ameyaw et al., 2014), who emphasized that with the absenteeism of a consistent legal and regulatory framework, the success of PPP projects is not guaranteed. The study reviewed the importance of an all-encompassing and striking PPP legal framework that defines the roles and powers of awarding authorities. Project developers, International Financing Institutions and various cooperating partners must be contented with the judicial system and commercial conflict and dispute resolution system in the hosting country. This risk is high at the planning stage of the HPP/PPP, because at this stage, several professionals consisting of engineers(Mechanical, Electrical, Civil, Mining, Geologists), economists, environmentalists, ecologists, sociologists and many other experts come on board in designing the project with the integration of technical, financial, environmental and social aspects of hydropower development.

Also, the licensing and permitting of the engineering design work for the construction stage is done at the planning stage. Thus, it becomes subjective to the legal and regulatory systems of the hoisting country to give a go-ahead. However, the process is affected by the lengthy approval process which can be attributed to incompetence and unprofessionalism of some public sector officials, multifaceted approval processes and poor legal/regulatory systems on implementing PPP projects. Therefore, it calls for the legal framework which has intelligibility of laws, all-inclusive laws including due process and certainty of outcome.

Legal/Regulatory Framework, as well as Institutional Capacity and delay in issuing project approvals/permits, were the most common risks accounting for 23.8%, 23.1% and 21.7% of all regulatory and legal risks respectively. The well established legal and regulatory framework has proved to supports mega infrastructure development through PPPs as it promotes investments, transaction costs reduction, and provides an enabling environment for the resolution of contract disputes and conflicts. According to findings by (A. Shrestha, 2015), which are similar to this research, is that the implementation of PPPs in China was highly affected by the poor regulatory framework and clarity of the laws. Sulser (2018), in agreements, states that legal and regulatory risks generate a prodigious deal of unpredictability in many developing nations, hence, the need for clarity on these legal systems. Delays in project approvals and permits were also cited as the most critical risks in a comparative study that looked at the risk perceptions of the PPP infrastructure projects in Vietnam (Likhitruangsilp *et al.*, 2017).

HPP are complex projects which have a long-lasting impact on the community and environment, hence, approvals and permits must be obtained for proceeding with the project stages. Accordingly, the application is made to the relevant authorities describing the project proposal including the existing environmental resources, perceived impacts of the proposed project on these resources, and projected mitigation measures. There are various requirements including statutory fees to be paid during the application process. In the Zambian setup, the application process attracts a fee of about 0.1 % of the cost of the envisaged investment. Upon filing in the application including the subsequent site visits by the Energy Regulation Board, if the inspection presets a positive outcome, the Board requires that the public comments on the project proposal during the process. The proposal is advertised in the Government Gazette for at least 30 days. The process is deemed tedious as it consists of the full description of the proposed detailed designed engineering works, technical cost estimation and scheduling, details of project financing including any power purchases or sale agreements and economic viability of the project with all the relevant econometric calculations. This process must be carried at the planning stage before any procurements works are done. This justifies the high risks due to the complexity of the process and bureaucratic tendencies. However, (Sikorova & Gallop, 2015), confirms that the difficulties and challenges of obtaining the permits/approvals for the development on the site differs between the countries.

b.)Risk Allocation

Public entities had a higher regulatory and legal risk allocation compared to private entities: nearly 50.6% of the risks were specifically allocated to public entities, 22.8% to private entities, and 23.6% were equally shared. The survey showed that legal/regulatory framework and delay in project approvals/permits were the most common forms of individual project development risks which were allocated to the public entity. Looking at the nature of the risks, the public sector is in a better position to manage them as have better control of the outcome cost-effectively. However, the full responsibility should not be the public sector alone, there is a need to share some risks between the partners. It is also the responsibility of the private partner to efficiently prepare the relevant documents during planning in readiness for approval. This assertion is in agreement with the (European Investment Bank, 2011), which state that the private sector has the responsibility for obtaining any planning permission and permits required while the public sector must give assurance through the contractual agreements on the non –delays in the issuing of permits. Though this risk is more allocated to the public sector, the private sector has some responsibilities to ensure that their part is also done in conformity with the required guidelines. To streamline private investment in the energy sector, reduce complications and bureaucratic tendencies in the project approvals and licences (Phiri & Ziba, 2018), the Zambian Government created the Office for the Promotion of Private Power Investors (OPPPI) under the Ministry of Energy to aid in this process.

The first objective of this research has comprehensively identified the various risks factors that can hinder the achievement of the project objectives and allocation to the party with the capacity to manage them. The effective allocation of the risks of HPP/PPP bears the quality of the partnership. Though the private sector gets more attracted to projects with fewer risks to manage, the findings showed that some risks must be managed by the private's sector. The results also revealed that allocating more risks to the private sector is not an economically viable decision as the cost is more on the public sector once the project is not delivered on time or abandoned due to financial risks or force majeure. Thus, an effective risk allocation is eminent and this study's results have shown that some risks must be equally shared.

Therefore, this study adopts a Prospect Theory (Kahneman and Tversky,1979) and Principal-Agent Theory as it ensembles well in the illustration of the project investors' decision choice. The theories are suitable for decision-making regarding project risks as it provides the atmosphere to interrogate the best conditions stakeholder prefer to take risks for a better economic outcome. The gains and losses are analysed before taking up the risk. The projects that have more gains and fewer losses will usually have more private investors. But the gains are more for those who take up more risks and revolutionise a well-designed risk management framework to manage them.

Finally, the misallocation of risks has been cited by many scholars (Stefan, 2014; Miranda Sarmento, 2014; Wang *et al.,* 2019; Kachapulula-Mudenda *et al.,* 2019), to be the main grounds of conflicts and disputes during the construction and operation phases of PPP Infrastructure projects resulting to non-attainment of Value for Money and poor sustainability of the project. Thus, well thought out and systematic risk identification and allocation is very imperative for the successful implementation of the PPP project.

7.3 Objective 2: To examine the effect of the risks and the probability of occurrences at Project Feasibility, Planning and Procurement Stage for Hydro Power Projects.

Objective 2 looked at the identified risks in the first objective in terms of examining the probability of the risks occurring and effects at the project development stage for the HPP/PPP. As per the systematic alignment of this work, the risks were clustered based on their seven (7) categories namely contractual risks, financial risks, economic risks, political risks, social/environmental risks, regulatory/legal risks, and technical risks.

7.3.1 Contractual Risks – Probability/likelihoods of Occurrence

The study showed that contractual risks were 'likely to happen (39%). Other probability occurrence chances were rated as follows: slightly likely (26%), somehow likely (26%), very likely (6%), and not likely (3%). Inadequate tendering was the highest contributor to the occurrence of contractual risks. PPP is the contractual agreement between the public and private in which various terms and conditions are negotiated, agreed and signed thereafter. The concession is signed between the parties to symbolize business relationships. The legality of the agreement is established and stipulates the obligations and responsibilities for the partaker, risk allocation, penalties, costs and benefits. However, due to the complexity of the HPP/PPP, the contractual landscape is not as smooth as any other contracts due to the manifold stakeholders, the variability of contractual terms and conditions, multi-jurisdictional stimulus and intensive regulatory requirements. It is from this precedent why it is important to understand the probability of any contractual risks occurring and the degree of effect on the project objectives.

The study revealed that the contractual risks are likely to happen on an HPP/PPP and the highest contributor to the occurrence is an inadequate tendering process. This finding is similar to (Neupane, 2018), who confirmed that the hydropower project in Nepal encountered a lot of contractual issues. Mbachu & Taylor (2014), study findings are similar to this research, which illustrated how the mega construction projects in New Zealand were affected by contractual risks and poor cost estimation, poor selection of sub-contractors and pricing were the main contributing risk factors.

7.3.1.1Contractual Risks – Effects of the Risks on Project development of HPP/PPP.

The impact of contractual risks on the development of hydropower projects was seen to be ‘substantial’ with a score of 59/140 (42%). Their results revealed a strong possibility or a considerable extent of impact which the contractual risks can have on HPP/PPP. The impact of the project could reflect on the quality of the service or product, frustration of the contract, delayed project duration and increased cost.

When these risks are not adequately dealt with, it results in increased cost, time and reduced quality. This study confirmed the factors that contribute to the substantial sources of these risks on construction projects are; poorly recruited technical team, not well experienced in PPP execution and management also political interference. Accountability/transparency was the highest contributor to the impact of contractual risks, accounting for 15/140 (11%). Lau Siew Soon (2012), endorses that the corporation between parties on a PPP arrangement is critical such that any lack of transparency and accountability creates the ground for negative consequences on the project and erodes public interest. Tshehla (2018), also settles that in the absence of transparency, it breeds misperception among the stakeholder that subsequently affects the benefits of the PPP projects.

Thus, with the findings established on this risk factor, since, HPP/ PPP are long term contractual agreements, for the enhancement of accountability and transparency, there is a need for institutions to scrutinize organizational structures, ethical standards, information access, political atmosphere and contract monitoring. And Liu *et al.*, (2016), on similar findings, stated that to be in a superior spot to edifice and accomplish the best tendering processes on PPP, there is a need for project brief quality, governance structure, communication effectiveness, and balance between streamlining and competition.

7.3.2 Financial Risks - Probability/likelihoods of Occurrence

The study showed that financial risks were 'likely to happen (39%). Other probability occurrence chances were rated as follows: somehow likely (25%), very likely (18%), slightly likely (14%), and not likely (5%). The results indicated that the financial risks have a high possibility of happening due to the complexity of the project, involvement of huge finances, capital markets, long term contracts and political interference which is associated with huge infrastructure development. And these financial risks affect both the public and private. These findings are similar to the study by (Chowdhury et al., 2016), which stated that most countries in both developed and developing nations identified huge financial risks to the public sector including the private sector. According to the World Bank (2009), despite the demand for hydropower infrastructure, there is a high shortage of project financing, intensified with the global financial crisis. And this challenge is more for the developing nations which have very poor fiscal policies on monetary measures and prudent institution capacity to manage the finances.

Financial accountability by both the officials from the public and private sectors managing the HPP/PPP is imperative for the success of the project. There is a need to get a deep understanding of the financial management regarding disbursement and utilization of huge projects, policies and guidelines established by the funding agencies. The hiring of transaction advisors with international expertise in the technical, legal and financial aspects of PPPs delivers gigantic value to all the phases of a PPP project. The consultants help to create and maintain the right financial platform environment that contributes to the smooth management of the project.

High bidding costs and local currency devaluation were the highest contributors to the occurrence of financial risks, accounting for 13% and 11% respectively. Cheung (2009), agrees with this finding by explaining that the common delinquent encountered in PPP projects is the high bidding costs. The author states that this is caused by the increasing complexity of the project and the lengthened procurement process. The other causes of the high bidding costs are the extensive negotiations including the cost of professional services for legal and financial facilities. The research also revealed that underbidding by some private entities just to win the tender and later on presents real costs which call for amendments or variations. Furthermore, some bidders are not interested to partake in this process due to the high cost of bidding. Corruption and lack of transparency surround this process where projects are awarded to well-linked politicians instead of those with the potential to add value to the economy.

The local currency devaluation contributing to the high financial risks has been cited by the researcher (Ong'olo & Spellman & Walker Co. Ltd, 2006; Barnett, 2017; Dean, 2014). This is one of the prominent financial risks which comes up when the foreign currency is used for the financing of the infrastructure development but the amortization is done in a local weak currency. That inters paying more than what was borrowed. However, the mitigation measure for the currency mismatch is the development of the local currency markets to cater to long-term local currency financing and for the availability of the hedging options.

7.3.2.1 Financial Risks - Effects of the Risks on Project development of HPP/PPP.

The impact of financial risks on the development of hydropower projects was seen to be 'severe' with a score of 30/80 (38%). This is one of the risks which must be managed well to ensure that both the private and public sector can meet their obligations to pay back their debts and achieve some return on investments. This risk has increased due to global and international trading which is needed for the developing countries that cannot raise local capital for mega infrastructure development projects. Investors, Transaction Advisors, and many stakeholders get concerned about how to manage financial risks. Noor & Abdalla (2014), findings indicated that financial risks leave a prodigious impact on the project performance that affects the procurement of capital equipment/machinery and maintenance for the same. The author also cites international trade and globalization that increases this risk during the project execution and operation stage. Another similar result is the research in Cambodia which encountered challenges in the development of hydropower projects due to a severe lack of technical and financial capacity to carry out project identification, planning, implementation and operation (Im, n.d.)

Cost overruns and schedule delays were the highest contributors to the impact of financial risks, accounting for 13/80 (16%). The cost overrun occurs in an event when the actual cost surpasses the budgeted project cost. Ahmada *et al.,* (2019), affirmed that large projects usually incur cost overruns, which have severe financial consequences with the potential of affecting the finance of a hoisting country. And for HPP which have civil works which account for 65-75% of capital cost(Kucukali, 2011), the factors that lead to cost overrun are the increase in the inflation rate and site geology including hydrology position. Braeckman & Guthrie(2016), also confirms with the findings of this research that studies carried out by the World Bank indicated that hydropower projects worldwide were experiencing an average 27% cost overrun.

Schedule delays have a direct correlation to the project cost overrun. When delays happen during the execution of the project, there is some direct cost linked with the suspension such as lost man-hours, idle time and loss of some material. That is the reason, during the contract negotiation, incentives and penalties are enshrined in the contract to mitigate this risk. The delay has an impact on the return of investment and amortization of the loans. Braeckman & Guthrie (2016), asserts that hydropower project delay could adversely affect the government who would want to commission the project and gain political mileage, the local people benefit from the project, the environment and the project financiers. However, the same author states that the construction delays work in favour of some local people as when the construction period is extended, the length of small contracts and other trading services around the project site brings some social-economic gains. In the same vein, there are some health impacts of hosting a large workforce in the area for a long time due to project rescheduling.

7.3.3 Economic Risks - Probability/likelihoods of Occurrence

The occurrence of economic risks in hydro-power projects was ‘likely’ with an occurrence chance of 38%. Other probability occurrences had lesser scores as follows: slightly likely (21%), somehow likely (16%), not likely (13%), and very likely (12%). Interest rates and exchange rate fluctuations accounted for the highest contribution to the occurrence of economic risks. The fluctuation of exchange rates and volatility of interest rates affects input factors of production that includes materials, capital and procurement of equipment/machinery. In an event of interest and exchange rates being high, it results in higher debt servicing costs which have got a serious impact on the success of PPP projects. To mitigate the same, the private sector increases the tariffs being paid by the end-users. And since these are long term projects, the cash flow can get affected by the increase in exchange and interest rates. This finding is similar to the research (Infrastructure & Mechanism, 2018), which stated that most projects encounter these risks due to the financing institutions which offers foreign currency and it affects the exchange rate, consequently, a local currency undergoes depreciation or devaluation.

7.3.3.1 Economic Risks - Effects of the Risks on Project development of HPP/PPP.

The impact of economic risks on the development of hydropower projects was seen to be 'substantial' with a score of 43/100 (43%). Interest rate and exchange rate fluctuations were the highest contributors to the impact of economic risks accounting for 12/100 (12%) and 11/100 (11%) respectively. This is finding is similar to (Yehoue et al., 2010), whose findings revealed that during the risk assessment, the economic risk was substantial. The fluctuation in the economic market concerning inflation and interest rates have a significant impact on the PPP return on investment due to long concessional periods. The change in the interest rate unswervingly affects the construction projects. PPP projects use project finance obtained from various leading institutions and cooperating partners which attracts certain interest rates when paying back. Thus, any change in the interest rates increases the economic risks. Equally, if the exchange rates are not locked on the long term contracts, once the local currency loses value, it declines the purchasing power of the project budget. It leads to construction cost overrun as the actual costs are higher than the budgeted cost. However, this is usually mitigated by requesting that the financing is done in a local currency, use of purchase price index by taking into accounts currency fluctuation, and the use of hedging instruments that includes future contract and currency options.

7.3.4 Political Risks - Probability/likelihoods of Occurrence

The study showed that political risks were ‘somehow likely’ to happen (38%). Other probability occurrence chances were rated as follows: likely (25%), very likely (19%), slightly likely (14%), and not likely (4%). The study revealed that political risks were among the extreme deterrent for any long time investments into emerging markets. However, where an enabling environment with a well-designed system of regulation is, the investors are motivated. The results indicated that the likelihood of happening was ‘somehow likely ’to occur due to the concerns that laws and regulations in most developing nations are prone to change unexpectedly. Another reason attribute to this result is that HPP/PPP are naturally characterised by a very long asset lifetime and contractual relationship. The payback is beyond the term of any existing political government making investors risk-averse due to uncertainty of the future governments.

Administration red tape and public opposition were the highest contributors towards the occurrence of political risks, accounting for 11% and 10% respectively. HPP/PPP involves a lot of documentation and procedures which calls for the Contracting Authority to ensure that there is revealing of all specific clauses in the tender and contract documents to reduce bureaucracy. However, the research revealed that despite the Zambian government having the PPP legal framework with established platforms such as; the PPP Unit, Council and Technical Committee on Infrastructure, there are still some high levels of administration red tape. The major causes attributing to these risks is that it is not just a government problem but also the fact that some public officers strive to expand their empire in any bureaucracy even without any business sense. There is also some tendency of public officers to increase their responsibilities and justifying recruitment of more staff duplicating or subdividing the same tasks creating administrative red tape.

Public opposition is intensified by innumerable strong disagreements with project proposals or execution. Valentin *et al.,*(2012), confirms that the high probability of occurrence of public opposition is because huge infrastructure projects capture public attention that can affect social-economic and environmental status. Thus, public opinion grants a source of great doubt in infrastructure development projects among the community.

7.3.4.1 Political Risks - Impact/Effect on Project development of HPP/PPP

The impact of political risks on the development of hydropower projects was seen to be 'substantial' with a score of 45/100 (45%). Inadequate distribution of authority between partners was the highest contributor to the impact of political risks accounting for 15/100 (15%). This finding is similar to (Sovacool & Walter, 2019), who confirms that HPP has a more internal and external political conflict that stems largely from water management. Among other factors that are attributed to political risks is that once HPP infrastructure is developed on the river basin, the value of the water supply to one or both sides is increased. This attracts the occurrence of militarized conflict over water territorial issues. And in an event of an international dispute, it can be used as a military tool to disrupt power generation or the dam may be attacked in the promotion of conflict agendas. When this occurs, it negatively impacts the social-economic fibre of the hoisting nation. An example is political tensions among Egypt, Sudan, and Ethiopia regarding the Grand Ethiopian Renaissance Dam (GERD) on the Blue Nile(Taye *et al.*, 2016). This has been triggered by the lack of an agreement between Ethiopia and the affected countries on the filling of the Dam's reservoir. It has attracted key cooperating partners and the international community to get involved of which the United States is already threatening the withdraw of development aid to Ethiopia due to prolonged resolving of the conflicts and not reaching an agreement.

Farinosi *et al.,* (2018), confirms that the impact of political risk is high due to the rivalry over limited water resources. The author states that the amalgamation of climate and population growth dynamics is what contributes greatly to the hydro-political risk impact on the already water-stressed basins that include the Nile on many river basins. Also, during the dam construction, two issues trigger political-cultural risk. This comes up when the construction works destroy some cultural sites which are underground remains of significant historical prominence and others are surface shrines, places of worship, cemeteries, spiritual, or religious meanings, created or used by historical and current generations. This creates a fertile ground for political-cultural risks. Cernea (2004), advises that best practices are that there is effective stakeholder engagement with regards to policies, programs and a well-executed risk management framework for HPP that need to protect various cultural endowments.

7.3.5. Social/Environmental Risks- Probability/likelihoods of Occurrence on Project development of HPP/PPP

The study presented that social/environmental risks were ‘likely to happen (42%). Since dams are usually located upstream where there are major population users, this gives a high probability of the social and environmental risk occurring. Barclays (2015), confirms this reasoning by elucidating that construction of HPP does take up substantial land that usually leads to largescale resettlement of many communities and reducing the accessibility of productive land. Equally, the water flow downstream is reduced affecting the livelihood and lifestyle of the habitants. It also gives a platform for more social and geopolitical risks where the dammed river crosses international boundaries.

Regarding environmental risk, HPP depends on the hydrological cycle. This is bound to be affected by climate change and geophysics of the particular region. Berga(2016), confirms that there is a high likelihood of climate change altering river discharge, affecting water availability, the regularity of water and the generation of power. Farquharson *et al.*,(2011), asserts that due to these environmental risks, a lot of efforts and long lead times are encountered for undertaking environmentally sustainable and socially responsible hydropower projects. In refining the environmental performance of the projects and limiting environmental risk occurrence, Lesinski (2001), reveals that project developers integrate ISO 14001-Environmental management systems (EMSs), which assists with the framework to effectively manage their environmental concerns.

Land acquisition and compensation problems were the highest contributors to the occurrence of social/environmental risks, accounting for 15% and 11% respectively. These findings are similar to those (J. Li & Zou, 2014) and (Hake et al., 2016), who revealed that land acquisition and compensation problems contributes highly to the social/environmental risks and plays a vital role in mega infrastructure development. And this is confirmed by (Batool & Abbas, 2017b), who cited that the major characteristic of the delays of the Ghazi Barotha Hydro Power Project was the land acquisition issue.

Regarding social impacts, due to the huge land space needed to accommodate HPP, there is massive relocation of communities living around the project. This calls for massive compensation for their lost livelihoods with the attempt to recreate the types of habitations lost, a case of Kariba hydropower project in Zambia and cabora Bassa & Mphanda Nkuwa hydro projects in Mozambique(Isaacman & Isaacman, 2016). Thus, Kumar & Freitas(2012), recommended the adoption of appropriate regulatory frameworks including building institutional capacities that facilitate income restoration and compensation projects on the affected communities.

7.3.5.1 Social/Environmental Risks- Impact on Project development of HPP/PPP

The impact of social/environmental risks on the development of hydropower projects was seen to be 'substantial' with a score of 36/100 (36%). The social impact is significant as these mega construction projects attract lots of local and foreign workforce that creates different culture and social harms. Social–culture tension is experienced due to different perceptions of issues by the immigrant workers and the locals. Furthermore, poor water management by the relevant river authorities aggravates existing tensions and social unrest.

Hydroelectric power generation is dependent on water resource availability, impacts affecting river flows, such as variation in rainfall, accelerated glacial retreat, and prolonged drought can present risks to the success of the project. Berga(2016), confirms that hydropower projects are highly sensitive to climate change impacts. Water which is the main input into power generation is not only affected by changes in the hydrologic cycle but also by climate-related changes in upstream water use. These may include increased use of water for human consumption, agriculture, industry, or biodiversity maintenance (IUCN *et al.,* 2004). An increase in temperature triggers the change in electricity demand. These factors have the potential to affect the HPP performance, thus the need for assessing a broader range of climate-related economic, social and environmental factors during the project development stage.

Despite HPP being renewable energy, Studies have demonstrated that HPP power potential tends to the gradual reduction in its potential due to climate change and increasing water demand (Yamba *et al.,* 2011). This is the reason this study attempts to mitigate the climate change risk on HPP, by developing a risk management framework with the integration of Climate Change Resilience.

7.3.6 Regulatory and Legal Risks- Probability/likelihoods of Occurrence on Project development of HPP/PPP

The study showed that regulatory and legal risks were 'somehow likely' to happen (42%). This entails that the regulatory and legal risks had the chance to happen on an HPP/PPP. The study revealed that as this risk was bound to happen, accordingly, various countries have embarked on projects to strengthen their institutional and regulatory frameworks for PPP Infrastructure development so that private investments are attracted. Legal and regulatory risks are directly connected to the reliability and enforceability of PPP concessions made by the Contract Authority on behalf of the public sector and the private sector. The occurrence of this risk unsettles the structured legal and contractual that postulate the rights and obligations of the stakeholders on the project. The legal and regulatory risks may manifest in form of abrupt changes of government policies and statutory instruments, breach of contract, licensing and permitting, interference by the hosting government in the project conflict/dispute resolution and expropriation by using certain pieces of legislature. Farquharson *et al.*,(2011), confirmed in their study that among the foremost apprehensions of private investments in massive infrastructure projects is lucidity and stability of the legal including regulatory framework.

Delay in project approvals and permits, as well as inadequate design details, were the highest contributors towards the occurrence of regulatory and legal risks, accounting for 14% and 8% respectively. Dunn (2017), settles with these findings by elucidating that risks are very common with complex infrastructure projects, thus environmental social impact assessments are part of the administrative requirements for official documents authorizing the use of land, expert labour, or any other resources that require official consent from the public authority. Zhang *et al.*,(2019), concerning this study's findings confirm that the permit process in most developing countries is too convoluted, most public sectors are in deficiency of PPP know-how and procedures leading to delays on the permit approvals.

7.3.6.1 Regulatory and Legal Risks- Impact on Project development of HPP/PPP

The impact of regulatory and legal risks on the development of hydropower projects was seen to be 'substantial'. Project permission was the highest contributor to the impact of regulatory and legal risks. Eberhard et al.(2016), confirms that the growth of HPP in most developing nations is enhanced with an effective regulatory capacity of the hoisting country as this improves performance confidence and financial sustainability. Ngoma *et al.*,(2014), in assertion, confirms that for the strengthening of the institutional capacity for PPPs and having well established legal framework, the Zambian government has established an independent PPP Unit which is domiciled at the Ministry of Finance. Furthermore, the Public-Private Partnership (Amendment) Act, 2018 was enacted to amend the Public-Private Partnership Act, 2009.

The research revealed that the private party are risk-averse and only invest in projects assumed to be fewer risks. Thus, enhanced investments are experienced more where there is higher levels of strong governance, no corruption, government efficiency and respectable quality of regulatory services. Wang *et al.*,(2019), in accentuating, states that the regulatory quality is the aptitude of the government to deliver effective regulations that permit and promote private sector development. This is done by monitoring the market dynamics, protection of the private sector's rights and property. Furthermore, regulatory quality respects the contractual agreements between the stakeholders and possess a positive element in attracting huge private capital investment. However, (WEF, 2015), argues that legislation alone is not adequate, as there is a need for meticulous implementation of the same by the relevant authorities. To mitigate the impact on the project, one of the attributes is that the private investors and the public sector must have confidence in the existing concessional dispute-resolution techniques. And this calls for the host countries to have transparent and reliable judicial capacity to administer the law in an autonomous, timely and competent mode.

6.3.7 Technical Risks - Probability/likelihoods of Occurrence on Project development of HPP/PPP

The study showed that technical risks were ‘somehow likely’ to happen (36%). Singh & Nachtnebel (2015) research is in line with these findings which revealed that since the hydropower sector is full of complex and conflicting preferences, the technical risks are high. Thus, hydropower projects require sound technical expertise from the project development stage to the commissioning stage that must be integrated to enhance the decision making. This is imperative as hydropower involves huge investment accompanied by full of uncertainties throughout its life.

Thus, expertise's contributions are highly needed during the feasibility study, detailed designing, engineering procurement and contract management, implementation of the project, operation and, implement, operate and maintain hydropower projects with sustainability plans.

The incompetent project team and quality of the hydrological cycle were the highest contributors towards the occurrence of technical risks, accounting for 8% and 6% respectively. Likhitruangsilp *et al.*,(2017), asserts that the incompetence of project management teams affects the implementation of PPP projects. Nkhungulu (2014), contributes that the high incompetence levels of the technical team lead to non-complying with contract deadlines, cost overruns, project relationship breakdowns, indecorous project planning and budgeting including derisory project organization structure.G. Kumar *et al.,* (2016), findings pointed to the fact that high levels of technical expertise enable the clarity in the understanding of the project while enhancing the efficiency through appropriate allocation of project resources, risks and schedule of responsibilities. HPP being a complex project with a lot of involvement of various stakeholders (Karekezi et al., 2003), states that technical expertise's are highly needed not only on the construction site but also to integrate analytical proficiency with project financing, social/community interest and environmental sustainability.

The results further indicated that poor hydrology scenarios were the highest contributors to the occurrence of technical risks. This is finding is similar to (Lumbroso et al., 2014) who affirmed that HPP must be based on adequate and reliable hydrological data for achievement of the generation capacity designed for. The literature survey also reviewed that the generation capacity is also affected by climate variability which subsequently affects the hydrological characteristic. Additionally, (World Bank, 2009), elucidated that the climate change risk affects the hydrological regime as the extrapolations of historical data is no longer reliable because the history is rendered a poor predictor of the future.

7.3.7 Technical Risks – Impact on Project development of HPP/PPP

The impact of technical risks on the development of hydropower projects was seen to be 'severe' with a score of 68/160 (43%). So the results indicated that the possible impact changes could affect the objectives of the project or entire HPP infrastructure when an implementation does not generate the anticipated capacity. Eberhard *et al.,*(2016), affirms that what has led to massive energy sector reforms and the encouragement of Independent Power Projects is the response to the technical risks. Kabanda(2014), confirms the impact of technical risks by citing the Bujagali dam which was expected to have a generating capacity of 250 MW but this was not achieved due to technical challenges exacerbated by poor hydrology. This was the same with HPP at Nalubaale and Kiira dams which were expected to generate up to 380 MW but only achieved output ranges between 110 and 135 MW which drastically affected the project objective.

Geology and technical design were the highest contributors to the impact of technical risks accounting for 15/160 (9%) and 12/160 (7.5%) respectively. The literature reviewed that Hydropower projects are directly influenced by technical design, climatological, hydrological, geotechnical, and geological progressions. Thus, (Lako et al., 2003), confirms that since HPP have a long design life, it is highly impacted by any changes from the initial input data. It is on this premise that various scholars on similar research (Y. Zhang *et al.,* 2015; Kirchherr & Charles, 2016; Ojukwu, C., Cheikhrouhou, H., & Kanonda, 2013) recommends that HPP must be designed with the integration of risk management and resilient measures to withstand a range of potential climate change scenarios. Ezzat Othman(2013), approves these recommendations by stating that mega construction projects such as HPP require high design knowledge and technical skills which must include competent human resources and managerial capabilities to mitigate the impact on the project objectives.

7.4 Objective 3: To develop technical inputs for risk management framework and register suitable for Zambia Hydro Power Projects implementation through PPP.

The study through this objective revealed the significance of some technical inputs which are cardinal in the development of a risk management framework for HPP in Zambia. The research further revealed the correlation between the technical inputs and the dependent variables which ascertain their significance. The technical inputs included; experience of stakeholders, features of institutional capacity, elements of private party appraisal and due diligence and essentials of technical project proposal appraisal. To statistically support the qualitative response, this researcher used multiple regression analysis to measure relationships between the independent and dependent variables and determine the degree of association among them. It was justified for the study to use multiple regression analysis since it is an appropriate method for measuring the degree of association between the dependent variable and two or more independent variables as well as the correlation coefficient which was used to establish the strength of the relationship. This technique has been used by many scholars in assessing the effect of the independent variables on the dependent variable on PPP infrastructure projects (Guo *et al.*, 2019; Allie, n.d.; Nasieku, 2016; Ngahu & Muturi, 2018). Thus both multiple regression analysis and hypothesis testing were employed in this study to test and develop the appropriate framework as per objective 3.

7.4.1 Experience of Stakeholders (SE)

On the examining, if the experience of stakeholders plays a critical role in the development of the technical inputs for a risk management framework for HPP, the results revealed that stakeholder experience (SE) significantly contributed to the development of technical inputs for a risk management framework for PPP Construction - hydropower projects. The research defined the dependent variable as a successfully executed HPP with characteristics such as; project be completed within the cost, time, budget, quality and satisfaction of stakeholders. The study revealed that there was a strong relationship between the experience of stakeholders and project success. And the statistical significance rejected the null hypothesis. This entails that the experience of stakeholders contributes greatly to the successful execution of HPP (Refer to chapter 6 section 6.7 for elaborative statistical assumptions). This finding is similar to (Desgrées du Lou, 2012), who postulated that mega PPP construction contracts are exceedingly complex and rigidity due to the involvement of various stakeholders. Thus, if their level of project experience is inadequate, it negatively affects project success.

Furthermore, (Wojewnik-Filipkowska & Węgrzyn, 2019), qualifies these research findings by clearly illustrating the significant importance and the relationship between the experience of the stakeholders and the project success. The author operationalized this hypothesis by stating that mega PPP construction projects consist of a coalition of powerful but often conflicting individuals and interest groups called stakeholders with the ability to influence the project success. The sum of the individual stakeholder's accomplishment is what to leads to the entire PPP project success. Effective engagement of the stakeholders on PPP projects supports sustainable development and also Bjärstig (2017), indicated that a sustainable contractual PPP relationship anchors the achievement of social-economic benefits and the improvement on the value for money achievement.

The positive high correlation between the experience of stakeholders and project success confirms Tp-a- (2011), who revealed that the success of attaining aspiring renewable energy objectives stakeholders must contribute to the development of supportive policies, innovative financing obtainability, and advanced technology growth. The high level of significant contribution by the experience of stakeholders (that includes government, private investors, donors, and international financial institutions) to HPP success can be credited to cooperative engagement in high-quality cohesive project preparation, creation of enabling investment climate and broad consensus on the apportioning of adequate resources in the needs to achieve the value of money and sustainability. (Olatunji et al., 2016) and Jacobson and Choi (2008) identified open communication and trust, willingness to compromise and collaborate, and respect as important factors for the successful delivery of public-private partnership projects. This is supported by Innes and Booher (2004) who emphasized the need for building trust between project stakeholders and resolving conflicts before they become intractable.

As stated in the literature survey of this research, climate change risks have got a high probability of affecting the sustainability of the HPP. Thus, IHA (2017), guilds that effective engagement of various experienced government institutions, local communities, non-governmental organizations, water resources agencies, meteorological and hydrological services and scientific institutes contributes decidedly to the resilience of a hydropower project. And this is attained through setting legal frameworks and regulations, providing institutional capacity building, climate resilience training and creating dialogue boards. It is this premise that creates a platform for HPP/PPP success and subsequent stakeholder satisfaction. J Plummer Braeckman & Guthrie (2016), consolidates this research's results which reveals the high significance correlation of stakeholder's experience and project success by elucidating that it is better to spend 2 years of effective stakeholder engagement to get the clarity on the project than encountering 4 months of project delay due to situations which could have been avoided if the former had taken place.

7.4.2 Institutional Capacity (IC)

Overall findings revealed that technical experts agreed (with a Likert scale of 2.37) that institutional capacity (IC) contributes to the development of technical inputs for a risk management model for PPP Construction - hydropower projects success. The contribution of institutional capacity to the development of technical inputs for a risk management model was highly supported by consultants, contractors, and sponsors. The regression analysis indicated the existence of a moderate positive correlation between Institutional capacity and project scope. However, further results indicated a strong positive linear relationship observed between predictor variables of institutional capacity and project completion time, project budget, project quality and satisfaction of project stakeholders. Stritzke(2018), confirms this finding that strong institutional capacity possesses as one of the critical success factors of implementing PPP. Johnson *et al*.,(2018), further agrees with these results by explaining that the energy generation crisis being encountered in Southern Africa among other reasons has been exacerbated by inadequate policy, regulatory and poor institutional capacity.

In covenant with these findings Chowdhury *et al.,* (2016), enlightens that PPP models to become an effective instrument through improvements in service delivery, efficiency, the achievement of value for money and sustainability, institution capacity must be able to competently accomplish the following; identification and selection of viable PPP projects; edifice contracts to ensure a suitable pricing and appropriate risk-sharing of risks among the stakeholder; institute a comprehensive and transparent fiscal accounting and reporting standard for PPP infrastructure projects; and establish legal, regulatory and monitoring frameworks that ensure and quality of service/product.

This research establishes that an effective institution framework capacity entices a durable class of private sector investments. This is done through the development of a clear rationale for PPP policy, supported by well-organized legal, regulatory, and investment charters. Besides, a resilient institutional platform is required in shaping and delivering policy, planning, preparation and procurement of the project outputs. This research has established that countries that have weak institutional capacity, faces challenges in managing complex PPP projects like HPP.

7.4.3 Private Party Appraisal and Due Diligence (PPADD)

The results showed that there is a moderate positive linear multiple correlation coefficient between Private Party Appraisal and Due Diligence (PPADD) and project scope, budget, time, quality and stakeholder satisfaction. Farquharson *et al.*,(2011), solidifies these results by explaining that appraisal of the private party including carrying out due diligence is highly imperative to the project success. The research further illuminates that due diligence is carried out on technical, commercial- pricing arrangements and terms, detailed financial models and legal bidding documents submitted by the private party. These documents commercially known as project dossier contains detailed information regarding the output specifications, suggested payment mechanisms, risk allocation, model designs and technical plans. The information needs to be evaluated to avoid substantial problems and surprises during the project execution.

However, PPIAF(2017), argues that due diligence should not just be performed by the public sector on the private party but the private party needs to carry out due diligence on the legal framework provided by the hosting government to determine its pricing, schedule of responsibilities and output performance expected. Hodge *et al.*,(2010), further confirms the importance of due diligence by the project financing institutions as it ensures that the project will generate sufficient cash flow to cater for loan amortization. Zack *et al.*,(2009), further agrees that due diligence by the project financing institution provides the public sector and the private investor the reassurance of the commercial viability of the project.

HPP/PPP being complex and involving long term contractual models, stakeholders should continue to perform due diligence reviews throughout the project. And the obtained data through monitoring must be meticulously shared among themselves. The risk register must be a live document that must be updated as the project progresses through the phases of the project life cycle. At the project development stage, several aspects of the projects that include risk identification and allocation, project planning and financing must be squared numerous times with increasing attention to finer details of each aspect. The technical and financial failure of the mega PPP project can be calamitous to the social-economic development of the nation. Thus, to reduce exposure to these risks it is imperative to have a thorough comprehension of both the technical capability and financial status of a potential private party before signing the long term agreement. The screening and due diligence process must be integrated with a high level of integrity.

7.4.4 Technical Project Proposal Appraisal (TPPA)

The correlations results between Technical Project Proposal Appraisal (TPPA) and project scope, project completion time, quality of the project, project budget including stakeholder satisfaction indicated the existence of a moderate positive linear relationship. The research findings are in line with Calderón *et al.*,(2018) and Farquharson *et al.*,(2011), with the revelation that both qualitative(valuation of possible impacts for the chosen PPP option) and quantitative techniques must be employed during project appraisal for the attainment of project success. The quality of the infrastructure project is achieved when project appraisal is enhanced with well-established procedures and good quality of institutional capacity. Furthermore, Cernea(2004), approves that in a situation where poor appraisal systems are used at the project development stage, little or no risks may be identified which can lead to failure to mitigate the same during the implementation stage.

However, (Burger & Hawkesworth, 2011), disagrees with this finding by elucidating that the appraisal of the project may be characterized by optimistic behaviour by the project developers, officials, politicians and other stakeholders. The optimistic could be regarding costs and outcomes. Just to ensure that the project is approved, there may be some intentional underestimating of the costs and overestimate the benefits of the project, especially where officials have to compete for funds from a limited budget. The author recommended that to mitigate this risk, there should be; increased transparency; the use of performance specifications; the explicit formulation of the regulatory regimes that apply to project development and implementation; and the involvement of private risk capital in public projects. Furthermore, Leigland (2018) opines that the ways of increasing mega PPP success, there is need to be cynical of the budget figures presented at appraisal, elimination of bias on the estimates of time to task completion, costs, and paybacks by demanding more extreme stress tests; and presentation of evocative cost-benefit analysis as part of appraisal procedure.

7.5 Development of Risk Management Framework and Risk Register for HPP/PPP

The final component of the last objective was to develop a Risk Management Framework and Risk Register suitable for stakeholders involved in Hydro Power Projects finalized under Public-Private Partnership. This initiative was taken with the view that when inherent risks are adequately identified, examined and appropriately allocated to the project participants on the development of HPP, it could promote economic growth and national development. The technical input factors to be integrated into the development of a framework have been discussed earlier in this chapter. However, the developed framework/model was subjected to validation and evaluation. The results are presented in chapter 8. De Jongh *et al*.,(2017) confirms that validation of the developed framework is very imperative if the framework is to be accepted and later on adopted by the stakeholders.

The experts interviewed by this researcher gave a technical justification for the need to integrate a risk management framework and a risk register at the project development stage of HPP/PPP. The justification was that these projects are so convoluted and characterized by lots of inherent risks which must be managed in a systematic and technical mode. Maharani assertions are in line with this research by stating that a well-developed risk management framework increases the success rate and minimizes including eliminating some risks during the project execution. The research cited the hydropower construction projects in PT PLN (Persero) which encountered a lot of challenges and motivated the need to integrate proper risk management on the projects.

The research also established the integration of risk management framework on a PPP model, conforms part of sound management practice and is an indispensable element of good corporate governance. Furthermore, it increases decision-making and augments outcomes and accountability. This finding is in line with Li *et al*., (2001), who stressed the importance of the framework on PPP due to a large number of uncertainties that affect this procurement approach. The other critical finding was that the risk management framework is aligned with the policy, not only is a structured process to identify the risks but also it proves to be an effective mechanism for planning, pro-active management of risks, effective allocation and use of resources, improved stakeholder confidence and trust, improved compliance with relevant legislation and effective monitoring and evaluation the project strategy technique. Rowlinson & Liang(2010) settles this research discovery by illustrating that the allocation of risks among the stakeholders is so critical and sometimes it gets confusing when making a decision. Thus, promotes the development of a risk management framework based on the resource-based view, organizational capabilities and transaction cost economics theories. Besides, the ISO 31000 emphasizes that the success of risk management on any project depends on the effectiveness of the risk management framework that provides the foundations and arrangements to enable the embedding of the same through the project life cycle(M., 2010).

The risk register for HPP/PPP with recorded details of all risks identified, analyzed and allocated including the proposed mitigation measure was equally developed. The development of the risk register is in phase with APMG(2016), which recommended the development of a risk register during the appraisal process as it encompasses the comprehensive overview of risk information. Issa *et al*., (2012) agreement state that in the execution of the projects in the United Kingdom, risk identification depends on the standard risk registers which also acts as a checklist technique. Hence, with the input from the literature review and data collected, the researcher developed the risk register that comprises of the following;

a.) Risk Source - Fundamental drivers that cause risks in a project.
b.) Risk Factor -Something that increases the chance of not attaining the objective.
c.) Risk Owner -An accountable point of contact who should be held responsible for providing leadership, coordination and risk mitigation.
d.) Risk Matrix- Score tool reflecting the Likelihood /Probability and Impact of the risk occurrence
e.) Risk Significance – the characteristic of the risk in terms of likelihood of happening or the impact it occurs
f.) Risk Class- the risk category as per the Likert scale
g.) Treatment Option- actions that can reduce the likelihood or consequences of a particular risk (i.e., risk mitigation).

h.) Risk Mitigation Measure- a strategy to prepare for and lessen the probability and impact of risks faced on the project

The proposed Risk Management Framework and Risk Register are presented in the next chapter together with the validation and evaluation results.

7.6 Discussion and Analysis of Qualitative strand of the study

This section presents the discussion and analysis of the feedback obtained from the qualitative strand of the study in a thematic approach. It has presented some areas of agreement by previous research with the findings of this research and possible divergent views. The summarized critical points have been adopted to be included in the risk management framework and risk register presented in the next chapter eight (8). Semi-structured interviews were used and the feedback was presented in thematic arrangements for easy comprehension. The strategy used by this author to enhance the quality of the analysis was focusing on extracting and corroborating the obtained information. The themes developed from the interview questions and responses are presented as follows;

7.6.1 Benefits and Drawbacks of HPP/PPP

The respondents enormously agreed that there are social-economic benefits with the development of HPP using the PPP model than through the traditional model. Many governments at the global level are affected with extra resources to finance huge projects due to other more competing needs such as health, education and other social needs. Thus, the governments look at the private sector to finance both social and economic infrastructure projects through the PPP model. It is assumed that the private sector brings in a lot of innovative technologies, due to inherent technical and financial expertise. Botlhale(2017) in agreement with these findings, affirms as many countries face economic crises, there is a realization that the private sector is not a competitor to the government but a strategic equity partner in driving the accelerated infrastructure development. Furthermore, experts opined that not only is the needed infrastructure developed but the use of PPP enhances the achievement of Value for Money due to proficiency, cost-effectiveness, dependable and innovative service by the private sector. Also, leads to the reduction of public sector budget deficiencies as the resources can be used to other competing sectors. Similar assertions have been brought out by various researchers (Effah Ameyaw & Chan, 2013; Ngoma *et al.,* 2014; Oyedele *et al.,* 2016) that PPP brings out efficiency in the delivery of quality projects due to the technical expertise which the private sector brings on board.

However, some divergent views were highlighted by the respondents who stated that though there are some known benefits, PPP projects are executed for a long time with the participation of many stakeholders resulting in complex processes in comparison to the traditional projects. Correspondingly, because of the complexities of HPP/PPP, there are a high probability of lengthier negotiation periods and higher business including transaction costs at the project development stage. Moreover, due to higher interest rates levied against the private sector by the financing institutions, in the long run, PPP projects may end up being more costly than the standard public projects. Furthermore, for the successful implementation of PPP, the institutional capacity of the public sector is very imperative, but in most developing nations, this capacity is lacking leading to PPP failures and legal complications. Some PPP projects have turned out to be a ”white elephant “ due to the public not appreciating the project caused by poor stakeholder engagement.

There is a need to understand that in most cases, the interest of the public sector and the private sector vary, as the latter is more interested in generating profit, whilst the former is interested in serving the need of the people. And lastly, the issue to do with the environmental concerns is not adequately tackled during the negotiations exposing the project to climate changes and sustainability concerns. Similarly, several scholars have rallied the same observations by agreeing that there are a lot of challenges in the implementation of the PPP model especially where there is a poor institutional capacity by the public sector (Boudott,2014; Olele, n.d.; Tshehla, 2018; Olele, 2016).

7.6.2 Importance of Legal and Regulatory Framework surrounding PPP’s and Mega Projects Execution

All the respondents’ acknowledgement that PPP infrastructure projects are usually administered by a complex legal and regulatory framework that requires well instituted fundamental policies. Fragmentized and inconsistent laws possess as an obstacle to the implementation of PPP projects. Regarding the responses from the experts and literature survey, this study deduces that just law is not adequate for PPP success, but adequate legal framework with the ability to address all rights, compensation on termination, robust system of audit, business transaction support, strong support for the financing systems and a public sector that considers the private sector as a cooperating partner in economic development. This contention is similar to Bain(2009), who emphasized that a solid legal and regulatory framework for PPP plays a critical role in specifying the rules of engagement among the stakeholders and a good platform to reduce the relevant risks. Foreign Direct Investments and Private Sector Investments is encouraged by the well-established credible policy framework which has high-level political support.

On the social piece, the presence of resilient regulatory and legal measures contributes greatly to the eradication of graffiti and corruption that dawdles on mega infrastructure development. This has been supported by (Wong & Kelley, 2010), who cited an example of hydropower projects in Laos, Cambodia and Vietnam which encountered low transparency, political interference, use of money and power to influence certain critical decisions and paying less attention to the communities and the environment at large.

7.6.3 Integration of Risk Management in HPP/PPP

The question of the integration of risk management in hydropower projects finalized through Public-Private Partnership received over warming support by all the respondents because all stakeholders look for a solution to project failures. This process precisely involves exploiting opportunity through enhancing the probability and effect of positive occasions and reducing the probability and effect of antagonistic occasions. As much as good corporate governance enables the smooth running of the projects by the organization, risk management provides the leadership in resilience on inherent risks. These findings are in agreement with (Daniella Nel, 2015), that risk management is an integral element of project management and sits as a higher-order management function in PPPs. Nel (2015) further relates to this research by stating that risk management in PPPs needs to be integrated at every strategic control process of the project so that the organisational strategic planning are heightened.

From the literature survey and responses received, the only strategic routine to avoid lots of risks/challenges on the project is the forward-thinking act. This is where project stakeholders develop the ability to look in the future and critically analyse the downsides or upsides of activities or procrastinations. To undertake this in a systematic and technical style with the incorporation of balanced thinking for the enhancement of effective decision-making, then risk management becomes necessary. Zou *et al.*,(2008b) confirm that risk management must be integrated throughout the project life-cycle perspective from the feasibility study stage up to 63the commission stage. The study recognized that only if there are adequate understanding and full capacity building in the risk management process, it becomes possible for a holistic risk management framework to aid in the management of risks.

7.6.4 Justification for Risk Management Framework on HPP/PPP

From the responses given by the experts on the justification of a risk management framework on HPP/PPP, it is interesting to note that all projects face risks and it is known that without risk, there is no compensation. However, too many much-uncontrolled risks lead to project failure. The study reveals that an effective risk management framework contributes greatly to the addition of value on the project and the organization including protecting its investment. Furthermore, the raising of equity and debt for the project is accelerated more where there is evidence of good risk management practices. Awodele(2012) stalwartly agrees with this affirmation that many projects incur high costs dealing with project problems that could have been minimized or eliminated with the aid of an effective risk management framework. To ensure that the framework is effective and able to meet or exceed project stakeholder's expectations, the following must be included;
Project objectives, Mandate and commitment to manage, risk operational policies including roles, responsibilities, procedures and practices.

7.6.5 Rationale applied in PPP Decision Making

The interest which has led governments around the globe to pursue the PPP model for infrastructure development is value for money and sustainability. The study revealed that the assessment of Value for Money (VfM) is mostly used when coming up with a decision to use a

PPP procurement model. VfM and Public Sector Comparator (PSC) are being used to decide on a PPP project. PSC is invoked when the bids submitted by the private sector are assessed against public sector benchmarks or estimates. The objective is to see how much it would cost the public sector if the project is executed by them. Thus, it is predicted that the public sector will attain VfM if the valuation reflects that the private sector can deliver the project more cost-efficiently. Muhammad *et al*.,(2016) justify this rationale by elucidating that the VfM translates to improved quality of the project objectives, higher efficiency, and lower costs.

However, LLP(2017), argues that there are many other factors that project stakeholders can put into consideration in determining that the public sector achieves VfM. These include:

(a) Effective Risk allocation on a PPP Project- it is envisaged that optimal risk transfer plays a key in determining the attainment of VfM on the project.
(b) Whole-of-life costing: consideration of all costs throughout the project cycle including operation and maintenance after commissioning.
(c) Innovation: application of innovativeness to meet the public sector requirements.
(d) Alternative asset use: an exploration of alternative revenue-generating uses of the facility. For example, on the HPP, the extra generated power could also be exported to other countries and not only restricting the Power Purchase Agreement signed with the hoisting government. The facility could also be used for training and as a tourist attraction.

Henceforward, various governments in developing nations must adopt vibrant operational guidelines to examine the suitable forms of PPPs, project identification and prioritization criteria, basic methodologies to risk allocation, a profound understanding of financial and budget to enhance the attainment of value for money. Thus, this author deduces that VfM analysis is just the initial commencement of the process of achieving value through a PPP. However, to get the best from the executed PPP, there is a need for extensive and careful propelling over the project lifetime and cycle. It calls for distinct contract management edifices, observant management of potential risks and a strategic flexible approach to managing changes.

7.6.6 Integration of Climate Change on HPP/PPP

The study revealed various potential risks which can affect the success of HPP/PPP, however, on climate change, the respondents exhibited anxiety and affirmed that probably it is one of the major environmental risks that have both positive and negative effects on the project. These findings are in line with Berga (2016), who stated that HPP and climate change exhibit a double relationship. Firstly, it is an important renewable energy resource and secondly, it contributes significantly to the avoidance of greenhouse gas (GHG) emissions and the mitigation of global warming. It makes a great significant contribution to achieving the targets of the Paris Climate Agreement and the Sustainable Development Goals. The availability of quality renewable energy infrastructure which is accessible and efficient contributes greatly to the social-economic growth of any nation(Shediac, Hammami, Abouchakra, & Najjar, 2008; O. Kodongo & Ojah, 2016).

Despite HPP being renewable energy, studies have demonstrated that HPP power potential tends to a gradual reduction in its potential due to climate change and increasing water demand(Yamba et al., 2011).Berga(2016) and Neupane(2018) confirms that there is a high probability of climate change altering river discharge, resulting in impacts on water availability, water regularity, and hydropower generation. Climate change affects the hydrologic cycle which disturbs the water flows also other climate-related changes in the upstream water use, such as increased use of water for human consumption, agriculture, industry, or biodiversity maintenance. Thus, the potential for precipitation patterns susceptible to change should be considered in project planning. Accordingly, there is a need to devise a strategic technique in achieving hydropower project purposes within the principles of time, cost, quality, safety, and environmental sustainability. This is the reason international financing institutions and governmental agencies are engaged in resilient investment for adaptation to climate change on the various energy projects. Braeckman (2008) and Mccann & Busadm (2014) in agreement with this author’s main objective recommends for the development of a well-designed Risk Management Framework (RMF) with the integration of Climate Change Resilience Measures (CCRM) necessary in the identification of the project needs, analysis of identified risks then incorporates the technical inputs for the successful implementation of HPP. And Berger (2006), confirms that several risks can be minimized or eliminated if adequate identification is conducted thoroughly during feasibility studies and planning stage.

7.7 Correlations Between Outputs and Outcomes -Value for Money & Sustainability on HPP/PPP

The research findings postulate a strong positive linear correlation between the predictor variables of project outputs and the dependent variable outcome -value for money and sustainability on HPP/PPP. The relationship between project outputs and outcome-value for money and sustainability on HPP/PPP was observed to be statistically significant (with a p-value of 0.000), signifying that the regression model was a good fit for the data being considered. These findings are similar to José Oliveira dos Reis & Cabral (2017), who postulated that the mega PPP Infrastructure projects presented good value for money, as the projects were executed within the schedule, costs, prudent bidding process, the incentive for quality by the stakeholders. Though various factors may influence the success of a PPP project, the focus should be on the value for money and sustainability.

However, Samuel Olusola et al., (2017), explains that it is easy to attain value for money due to frequent changes in specification, unsuitable selection of contractors and consultants, poor quality, technical inadequacy, poor project management techniques, poor communication and unreliable risk assessment and management across different stages of the project. Thus, *Samuel Olusola et al.*,(2017) and Desgrées du Lou(2012), in line with this researcher's findings, states that the project costs, risks, technical capabilities need to be identified at the project development stage if the value for money is to be achieved.

Furthermore, the results indicated a strong response that a well-designed Risk Management Framework/Model can be used to identify and maximize the positive risks that will bring positive opportunities to maximize value for money and attainment of sustainability on PPP hydro projects. Darvish and Zou *et al.*,(2008a) confirms that a well-developed risk management model with viable risk identification, analysis, optimal allocation, management from a life cycle perspective including the balanced interests between the public and private sector partners contributes greatly to the achievement of value for money. There is a need for the equitable allocation of risk between the public and private sector partners to achieve the intended goal as there is always some inherent conflict between the stakeholders.

The interview with the experts by this author established that HPP/PPP must embrace suitable performance measurements which must serve as an effective and decisive method to ensure the sustainability of the project. Liang & Wang(2019), argues that executing the project on time, cost and quality does not easily make the project sustainable as inherent complex project features and long duration make PPP projects more risk in adopting traditional triangle performance measurement models. Hence, achieve HPP sustainability, life-cycle perspective and stakeholder management must be well emerged in the establishment of performance measurements for PPP projects. The project's performance must be measured from multiple stakeholders' perspectives and thereafter integrate their considerations and interests that contribute to the social-economic and, environmental aspect. And this must be carried out in a long-sighted manner with the recognition of uncertainties and risks in the long project life.

7.8 Chapter Summary

The chapter presented the discussion and analysis of the findings from both the qualitative and quantitative components of this research. The entire arrangement was custom-made in line with the objectives and the structure of the research instrument used that included the Delphi Technique, questionnaires, semi-structured interview guild and sit visits. The chapter has provided an insight into experts' perceptions on the integration of risk management on HPP/PPP. The chapter has brought out various arguments and discussions regarding HPP/PPP which could greatly contribute to project success. Furthermore, as discovered in the extant literature, there is a general view held within the project stakeholders that adequate management of risk is crucial to the success of any construction project? And this does not only apply to privately funded projects only but also public-funded projects. That is the reason the chapter has profoundly discussed the identification of risks, probability of the risk occurring, impact on the project objectives and risk allocation. After an in-depth analysis of data, this author deduces that apart from the four mentioned theories in chapter four, Bargaining Game Theory is so visible on PPP projects. Shen *et al*.,(2007) illustrate that this theory is the process in which stakeholders possess a mutual interest and realize that profit is an agreement rather than a disagreement but with some contradictory interest.

The discussion and analysis held in this chapter, have been summarized in conjunction with literature from the previous chapters and further incorporated in the proposed risk management framework and risk register as an output from this researcher (refer to chapter 8).

CHAPTER EIGHT

FRAMEWORK & RISK REGISTER DEVELOPMENT, VALIDATION AND EVALUATION

"Third-party testing is a validation of the process".
Brian Hall (2003)

8.1 Introduction

The study pursued to develop a risk management framework and register suitable for hydropower projects finalized through Public-Private Partnership. The two instruments which are part of the output of this research was specifically designed for the project development stage that consists of feasibility, planning and procurement stage. It is envisaged and supported by literature in this research that a well-designed framework at the project development stage with the effective ability to identify, analyze, allocate the inherent risks on HPP enhances project success. Thus in line with objective three, this chapter now presents the proposed risk management framework and risk register. The presented works consist of inputs from chapter one to chapter seven including the research theories and variables. The conceptual framework in chapter four referred to by this research as Alpha has been developed in Beta in this chapter after the incorporation of various factors.

The validation and evaluation of a developed framework is an essential part of a framework development process so that it be accepted and utilized in decision making on projects(Chandy *et al.*, 2012*)*. Furthermore, the most common question asked by the scholars who would like to use the framework developed is if it has been validated by experts in the particular field (Macal,2005). Hence, for this author to tackle this question and many more similar interrogations, this section designates the processes by validating the framework and the risk register. The results for the validation have been presented thereafter in this chapter.

8.2 Framework and Risk Register Development

8.2 .1 Risk Management Framework Development

Literature survey data, qualitative and quantitative results including the integration of theoretical analysis were incorporated in the development of the framework for managing risks on HPP/PPP attached as Appendix (iii). The summary of the results obtained contained;

a.) The identified inherent risks ;
b.) The probability of the risks occurring and impact on the project objectives if they occur;
c.) The allocation of the identified risks to the party with the capacity to manage the risks, and;
d.) The technical inputs in the development of the risk framework and their relevant significance levels.

The literature explored various risk management frameworks/models which are being used on construction projects. Since, HPP is one of the mega construction projects, certain factors relevant to this study were adopted. Depiction from the theoretical analysis which came from the broad literature survey and the results from the exploratory mixed-method embraced, a risk management framework was developed encompassing three parts. The first component consists of preliminary steps in the HPP/PPP development. It is thus known as the pre-feasibility stage. The framework second component consists of the planning stage. This is the most crucial stage that a lot of stakeholder engagement is involved and all critical factors must be incorporated. The third components show the procurement stage. This presents all the process involved and ensure that there is an award of the concession. All these three components are incorporated in the risk management process. The strategic risk management knowledge box sits at the special initial stage just after the project has been identified. These three framework components are elaborately presented in the following paragraphs:

8.2.3 Framework Systematic Processes involved in HPP/PPP

The framework has been divided into the project development stages (Strategic and Feasibility, Planning and Procurement). The processes have been explained as follows;

a.) Feasibility Stage

1. ***Identification of the Project***: The public sector is responsible for this stage and thus have the needed expertise including the durable institutional capacity to handle the activities on this stage. The involvement of Technical, Legal and Financial Advisors/ Consultants is highly imperative. The first activity involves the identification and justification of the project. The social-economic factors must be over warming for the project to be justified. The need for the project must be evidenced by the current demand.
2. ***Systematic Appraisal (Demand & Opportunity)***: preliminary systematic appraisal to obtain certainty on the demand and opportunities surrounding the identified project is the second activity. Economic, social and environmental cost-benefit analysis is performed on the proposed project. Both local and regional demand for the project is examined including Value for Money (VfM) including the procurement model to use. The affordability test is carried to ascertain the best procurement model that enables the attainment of VfM. If the analysis indicates that PPP is not suitable, the Project is pushed to the public sector or cancelled. If it qualifies, the PPP model route is enhanced with the third step.
3. ***Documentation Review***: This enables the Project Team Members to look at the specific project-related documents that include; HPP risk registers which were developed for similar projects. This is cardinal as it provides the team with the lists of significant risks that are associated with HPP and proposed mitigation measures; the geological history provides information regarding land degradation and groundwater protection. It also contributes to making an improved decision; topographical data helps the team members to have a clear vision and perception of the land to be used for construction. The contours, spot levels and feature lines provide accurate inputs to be incorporated during planning and designing; and finally, the hydrology information is very imperative for HPP on which water availability is the main input. Thus, knowledge of quality, integrity and sustainability of water flow is important for consideration during the design, build and operation of the dams. Once this technical data is assembled, the process proceeds to the next step.

4.) ***Estimation of Potential Energy and Engagement of Stakeholders***: The rough estimates of the potential energy is calculated based on the preliminary technical data covered. This information is then used to engage various stakeholders to buy into the project. The stakeholders include the community members, government officials, environmentalists, non-governmental organizations and any other key relevant statutory bodies with a stake in the project. If there is consensus among the key stakeholders, the project proceeds to the next step and if it is negative, it is dropped or suspended until more data is provided.

5.) ***Technical Economic Analysis***: This process gets more technical as simulators are now used to envision the plans of the project by using the parameters gathered. The environmental social impact assessment is carried out to predict and assess the potential environmental and social impacts of a proposed HPP. It further evaluates the substitutes and development of appropriate mitigation, management and monitoring measures. At this stage, the Public Sector Comparator (PSC) is established as the data is now more refined and the assessment of VfM can be done. At this moment, the next process continues to the next step.

6.) ***PPP Department & Involvement of Experts***: At this step, the Contracting Authority submits the proposal with all the preliminary estimates and calculations to the PPP Department and who subsequently engages the experts/consultants to guide this PPP project. The consultants enhance the preparations of the Outline Business Case and carry intensive risk management on the proposed project. This makes the next step

7.) ***Risk Management Process***: An extensive identification, analysis and allocation of the risks is carried out on the proposed HPP/PPP. The input into this process at all the preceding steps feeding into this component. The prepared documents are then taken to the next step for approval

8.) ***Committee of Senior Government Officials Approval***: The developed risk register and the Outline Business Case is approved by the committee for further technical analysis and project planning by the experts.

9.) ***Planning Stage***: At this phase, the experts consisting of Engineers, Environmentalists, Financing, Socialists, Hydrologists and Geologists carry out detailed planning of the project. The scheduling, scoping, methodology and costing is done. The Climate

Change Resilience Measures (CCRM) are also integrated into the planning of the project. The Inputs from all participants is imperative to yield the best plans for the success of PPP. Thereafter, Expression of Interest and Request for Quotations is now floated on the market.

10.) ***Private Party Invitation and Techno-Commercial Adjudication***: Through open bidding, the PPP department solicits for expression of interest or request for a proposal from the private sector. A deadline is set for the submission of the bid. The private party is permitted to access the site and carry out any preliminary reconnaissance of the project site. The documentation regarding terms and, conditions including any relevant legal/regulatory framework are shared with the prospective bidders.

11.) ***Technical and Commercial Adjudication including shortlisting of Potential Private Party***: At this stage, the proposal/bid is more technical and commercial and does not contain the costing aspect. The submission is based purely on the conceptual detailed design and some aspects of the commercial component. Thus, the PPP department is expected to have the needed institutional capacity (among others; quality assurance system), technical expertise with the relevant qualifications and must have the experience to adjudicate the technical proposals submitted. The proposals must be assessed with completeness and compliance with the set minimum requirements of the bid process and the evaluation criteria. Thereafter, an evaluation report is prepared with a detailed comparative analysis based on the evaluation terms. Corporate governance, transparency and accountability are the key factors that attract private sector participation in this process. Accordingly, it is imperative. However, if there is no satisfaction with the received bids, the process is re-advertised and more clarification is given to those who require more information.

12.) ***Second Stage Bidding Process***: The shortlisted Private Party carry out the independent full feasibility of the project with the guild from the pre-feasibility done earlier by the public sector. They further re-assess the risk register and proposes any amendments to the risk allocation strategies including the cost implication. This time the costing aspect is included in the final bid with the full business case is submitted.

13.) ***Final Evaluation of the Bid and Full Business Case***: The bid is evaluated in terms of the technical, commercial and financial aspects. The proposed project financing is analyzed and simulated to the prevailing situation to conform to the applicability. The equity/debt ratio is equally assessed. Since the public sectors are envisaged at this stage to be well vested with the project estimates, it is expected to bring in the Public Sector Comparator and compare it with the private sector bid. The aim is to evaluate if VfM can be attained with the proposed model of procurement. The best proposal is eventually selected after exclusive analysis.

14.) ***Final Contractual Negotiations and Award of Concession***: The final contractual negotiations in which various terms and conditions are agreed upon is settled at this stage. Also, the final risk register is signed off ready and secured. The performance specifications, incentives and risk-sharing parameters are discussed comprehensively and unswervingly both to achieve efficient performance by the concessionaire and to lessen post-award renegotiation. The best practice is for the process to be governed with utmost transparency, accountability and economic efficiency, including the integration of sustainability measures.

8.2.4 Risk Management Process

This is the most critical component which must be systematically carried out with the full consultations of all key stakeholders. The steps are outlined as follows:

a.) **Risk Identification**: It involves the process of determining risks that could hypothetically hinder the achievement of the project objectives due to either a positive or negative impact. The identified risks must be comprehensively documented and presented to the next stage for analysis. There are various techniques used for identifying which includes; Checklist, Personal and Corporate Experience, Brainstorming, Site visits, Flow charts, Delphi, Interviews and Surveys, Analysis of Assumptions and many more not mentioned by this research.

b.) **Risk Analysis**: This step goes deeper to comprehend the probability of the occurring of the identified risks and subsequent impact if they occur. Both qualitative and quantitative techniques are employed when analyzing the risks. The importance of using both approaches is that it ensures that risks are on the project are viewed comprehensively. On the mega construction project, the selection of the analysis method is very imperative. Thus, the risk analysis process consists of three components such as planning, risk assessment and risk treatment. Some of the risk analysis techniques include; Risk Probability and Impact, Decision Tree, Sensitivity Analysis, Multi-criteria decision making, Probability Analysis, Monte Carlos Simulation, Analytic Hierarchy Process, Program Evaluation and Review Technique and many more not mentioned by this research. The graphic representation of the risk analysis process is shown in figure 8.1

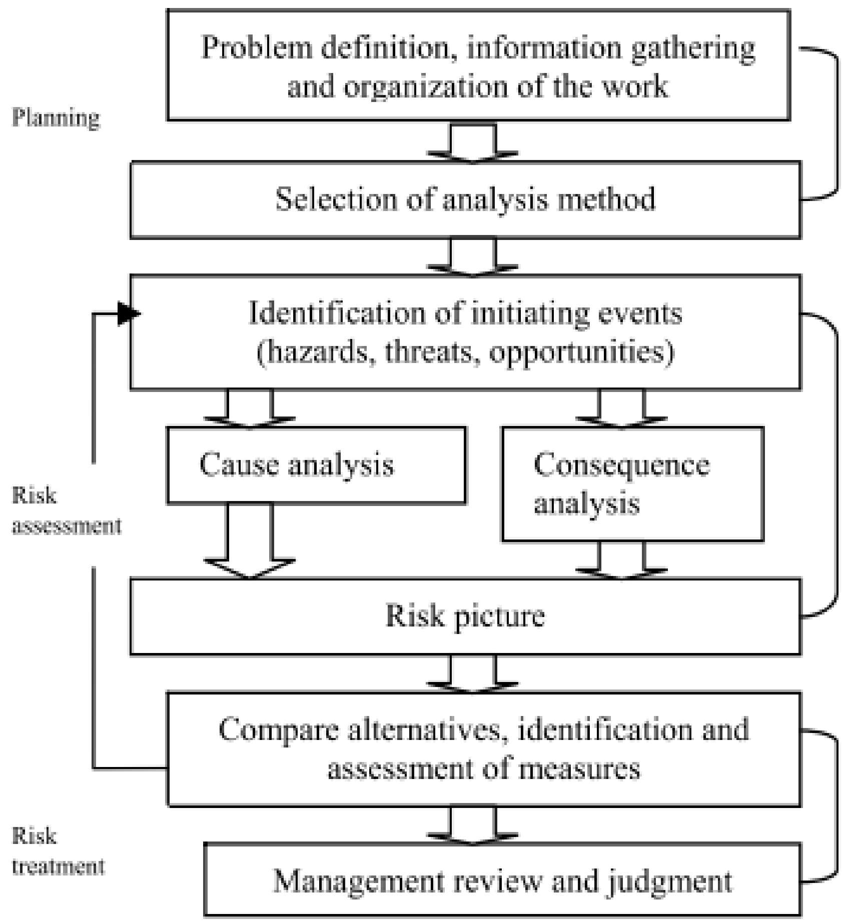

Figure 8. 1: Risk Analysis Process Flow: Adapted from (Korombel & Tworek, 2009c)

c.) **Risk Allocation**: With the consultations with various key stakeholders, the risks are then allocated to the party(Private or Public Sector) with the wealth and capacity to manage them effectively. And some risks are equitably shared among the project parties. It should be noted that the party that plays an important role in the contribution of the project success, the more risks they bear. The importance of risk allocation is that there is an assurance that every risk is recognized and managed effectively. This is a very cardinal process as it significantly influences the behaviour of the project participants that subsequently impact the performance and final cost of the project. The process is characterized by negotiations, if the private party is not comfortable with some of the risks allocated to them, they trigger negotiations with the public sector settles for the optimal position and compensation.

d.) **Development Risk Mitigation Strategies**: At this stage, the Private and Public Sector develops the strategic risk mitigation measures to manage the risks in their custody. This process is vital as it enables the parties to develop premeditated options and actions to heighten opportunities and lessen coercions on project objectives. To implement this process the strategies which are applied include risk avoidance/elimination, risk transfer, risk sharing, risk reduction and risk retention. There is a need to comprehend that risk management flows in a continuous loop, hence, upon setting the mitigation measures, the next step involves monitoring and reviewing the strategic decisions. This continues throughout the project life cycle and in this case, it is throughout the project development stage.

8.3 Framework Validation and Evaluation

To prove the reliability and validity of the risk management framework, validation and evaluation which are complementary to each other are very imperative. The importance of validation is to ensure that framework developed is correctly structured and to eliminate any errors/mistakes on the framework. Also, validation ensures that the framework/model is clear for any class of readers. Also, validation ensures that the framework /model is developed to meet its envisioned purpose and achieve results in line with the theories assimilated(Awodele, 2012). Thus, it was inevitable that this author subject the developed framework for the validation and evaluation process. Awodele(2012), confirms that is no rigidity or specified guidelines that must be put into consideration when carrying out this process as developed frameworks /models are unique depending on the objective. Hence, for this research, the author invited experts drawn from academics, industry and government to validate the developed framework.

For the validation process, this research adopted two of the four steps recommended by Yahaya (2008) which is the conceptual model process and validity of the data used by the research in the development of the model. The two steps are operationalized as follows; the first step entails measuring the significant degree to which the framework /model representation will solve the problem at hand, and the second step manages the valuation of the data validity used by the researcher during the development of the framework. This research did not use the other recommendations which specify computerized models because the research brought out extensive literature in chapters 1, 2, 3 and 4 including the validation of technical inputs used for framework/model development in chapter 6 of this thesis.

This author during this research learnt that validation of the developed framework /model cannot be carried out by the author but with the involvement of key stakeholders who will be using the same. This is in line with Martis(2006), who recommended that end users must verify and validate the developed systems. Thus, this author swiftly identified potential key stakeholders who would be using this framework to validate the same. These included; Policymakers from the Ministry of National Planning and Development, Ministry of Energy and Ministry of Finance, Officials from the PPP department, Officials from Financing Institutions, Energy Experts, Private Sector Investors and Academicians.

Awodele(2012), recommends that the validation and evaluation process must be carried out in such a manner that it proves that the intended objectives are met, the structure is appropriately conscripted and its logic is in line with the research philosophy (pragmatic) and it is clear enough for all stakeholders to apprehend. Thus, to achieve this endorsement, this research employed both face validity(Hillson & Hulett, 2004; Chung, 2012) and scoring framework/model approach (Demirag et al., 2010). With the Face validity Approach, the end-user confirms the appropriateness, significance including the exactness to which variables appears to measure the intended purpose (Johnson,2013; Fraenkel & Wallen, 2006; Patton, 1997). Accordingly, this author ensured that the framework was constructed with the concepts drawn from the entire study, that the content fully represented what was supposed to measure and lastly the suitability of the framework was ensured by comparing with another related model/framework developed for mega construction projects finalized through PPP.

The second approach used the Scoring Model which solicited for experts to score the framework based on their extensive knowledge and experience on similar frameworks. The experts validated and agreed/disagreed on certain variables that influence the output and outcome of the framework. The framework was expected to be assessed on the logical construction of the framework, the simplicity of the framework and the exhaustiveness of the framework. Respondents also commented on the strength and weaknesses or shortcomings of the framework. This approach has been used by (Zhang et al., 2018; Miranda Sarmento, 2014; Awodele, 2012), to score related frameworks similar to this study.

This author established that these two approaches are mostly either used concurrently or simultaneously as revealed from a literature survey. However, due to the limitation of resources and the Covid 19 pandemic which globally affected most operations, this author decided to combine these two approaches and leverage on availability of the few experts who were still willing to participate. It was a sad situation especially at the beginning of the year 2021 as most of the potential participates earlier contacted during fieldwork for future validation and evaluation of the framework either had contracted Covid 19 virus and isolated in hospitals/homes or passed on. Unfortunately, this research suffered such a loss as 3 of the main recognized experts passed on before the evaluation and validation work was done. Thus, this author struggled to meet the intended sample size of about 16 experts from various strata.

The combined validation and evaluation process which this research named Collective Face-Scoring Validity Approach has been operationalized in the next section.

8.3.1 Collective Face –Scoring Validity Approach

For the effectiveness and efficiency of the process, the three-step approach was used to validate and evaluate the developed framework. Firstly, the framework was sent to the PhD Supervisors via email for critic, recommendations and approval. After incorporating some suggestions from the Supervisors, the developed framework and an evaluation instrument (see appendix (iv)) were then emailed to key stakeholders who were the potential users for this framework as stated in the earlier section of this chapter. The email had instructions for the respondents to carry out two activities; face validity (second step) and framework/model scoring (third step) respectively. These activities have been adequately elaborated on in the earlier section of this chapter. In the third step, not only were the respondents requested to quantitatively rate the framework but also some qualitative data was obtained through open-ended questions which requested respondents to make a general and technical comment on the framework, strengths and weaknesses of the framework.

The sample size was at least 2 from each stratum of the targeted population (sample size 16). And purposive sampling technique was utilized as this is a specialized field that entails only participants with prior experience and knowledge must participate. Out of 16 targeted sample sizes, only 10 were available to respond due to the reasons earlier alluded to in this section. Thou, the sample size was small, it was compensated with qualitative data which was obtained on the evaluation instrument on the excellence aspect, acquaintance, worth and experience of the respondents. The methodology used is consistent with what was used in the collection of the main data of this research. HPP/PPP is a highly specialized project in which not many potential respondents have got full knowledge and experience. Thus, the purposive sampling technique favours this research.

Table 8.1 displays background information about the respondents. It is noticeable from the table that all the five identified potential users of the framework were sufficiently represented. For instance, 30% of the respondents are from Academic/Consultants, while Contracting Authority, Financing/Insurance Institution, PPP Department were at 20% and 10% came from the private sector. The minimum academic qualification of the respondents is shown in the table area as follows; 10% Degree, 50% master degree and 40% have a PhD in their various fields of study.
Based on the preceding background information about the respondents, it can be established that the evaluation provided by the respondents can be relied upon as a true and rational assessment of the framework.

Table 8. 1: Background Information of Respondents

Category	Classifications	Frequency	Percentage (%)
Type of Organization		Frequency	
	Contracting Authority (Energy Ministry)	2	20
	Academic/Consultants	3	30
	Financing /Insurance Institution	2	20
	PPP Department	2	20
	Private Sector Investor	1	10
	Total	**10**	100
Academic Qualifications			
	Degree	1	10
	Masters	5	50
	PhD	4	40
	Total	**10**	100
Experience in PPP related Construction Projects	5-10 years	2	20
	10-20 years	6	60
	Above 20 years	2	20
			100

The respondents confirmed that the framework developed was in line with the systematic and technical flows in HPP/PPP including the integration of the risk management. There was general agreement that the developed framework has the potential to minimize and eliminate various inherent risks associated with HPP/PPP at the project development stage.

8.3.2 Framework Validation

The framework was validated by 10 experts based on a five-point Likert scale in which 5,4,3,2 and 1 represented the following responses: "Excellent, Very Good, Average, Poor and Extremely Poor. A mean score threshold for the determination of the validity of the framework was set at 3.0 which corresponded to the mean score of 'Very Good' on the Likert scale. The conditions for the selection of the framework validation respondents was such that they met at least three of the following criteria:

a.) At least five years' experience mega construction industry and in-depth understanding of PPP models.
b.) Possess a minimum of BSc or BEng.
c.) Has Professional registration with Engineering Institute of Zambia or Association of Consulting Engineers of Zambia Institute of Architecture.
d.) Senior member or Head of Unit in a private or public organization.

Table 8.2 shows how the framework was rated by experts. Mean scores for the various evaluation criteria ranged from 3.90 to 4.60 implying that the framework was highly rated by the experts. Figure 8.1 shows the overall mean scores of the framework against the assessment criteria. It is noticeable from figure 8.2 that the respondents score the framework in terms of its practical relevance to the Risk management concept in the PPP Construction Project and the simplicity of the framework, with the highest mean score of 4.08. Though 3.9 which was the lowest mean score for the logical structure of the framework, it was still above the average. This variable sought to assess the consistency of the framework with the characteristics of the real system. In other words, it sought to know whether the framework is logically disjointed or is incoherent with the real-life situation.

Furthermore, it is palpable from figure 8.3 that the response rated the framework 86.67% and 70% very good and excellent respectively. Although 10% score the framework as average, the respondents did not elucidate the specific items to be included. Thus, this study deduces that the framework is sufficiently comprehensive for risk management on HPP/PPP.

Table 8. 2: Framework Assessment

Framework Evaluation Criteria (FEC)	**5**	**4**	**3**	**2**	**1**	**Mean Score**
The logical structure of the developed framework	1	7	2	0	0	3.90
The simplicity of the framework	6	4	0	0	0	4.60
The extensiveness of the framework	3	7	0	0	0	4.30
Practical relevance to Risk management concept in PPP Construction Project	6	4	0	0	0	4.60
applicability in PPP/ Hydro Power Construction Project	5	4	1	0	0	4.10

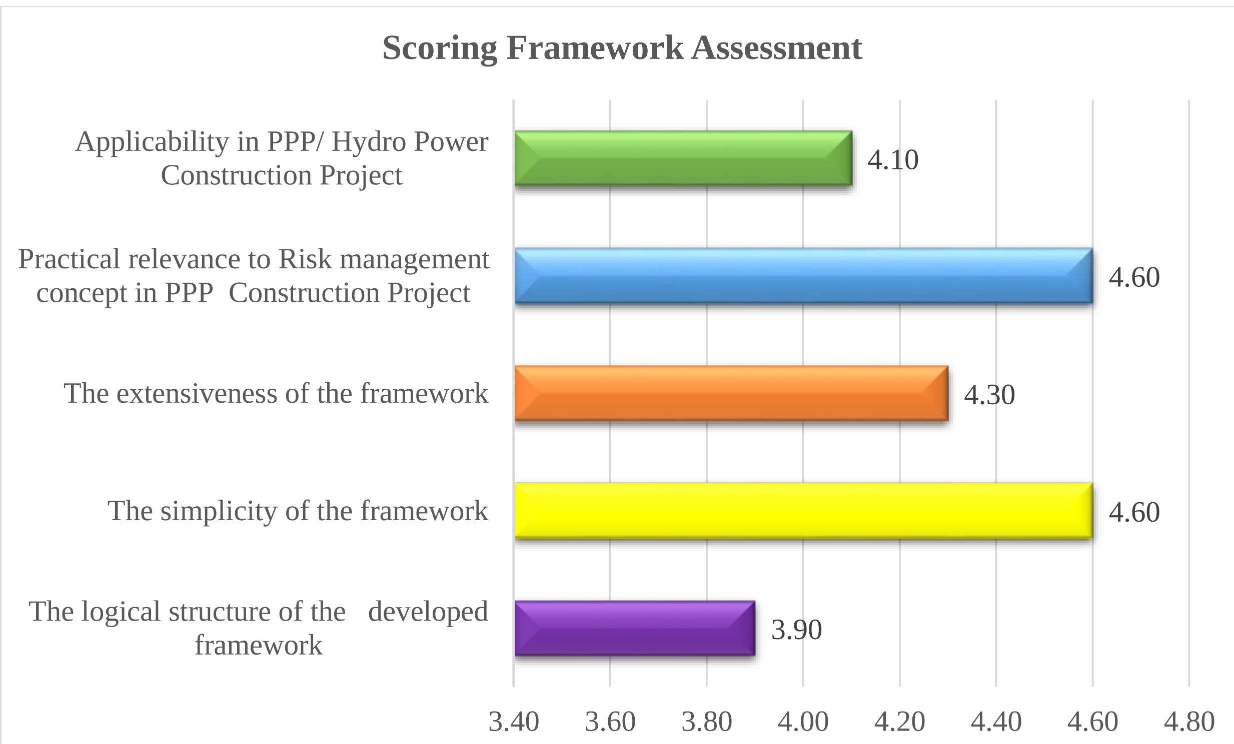

Figure 8. 2: Scoring Framework Assessment –Source (Author, 2021)

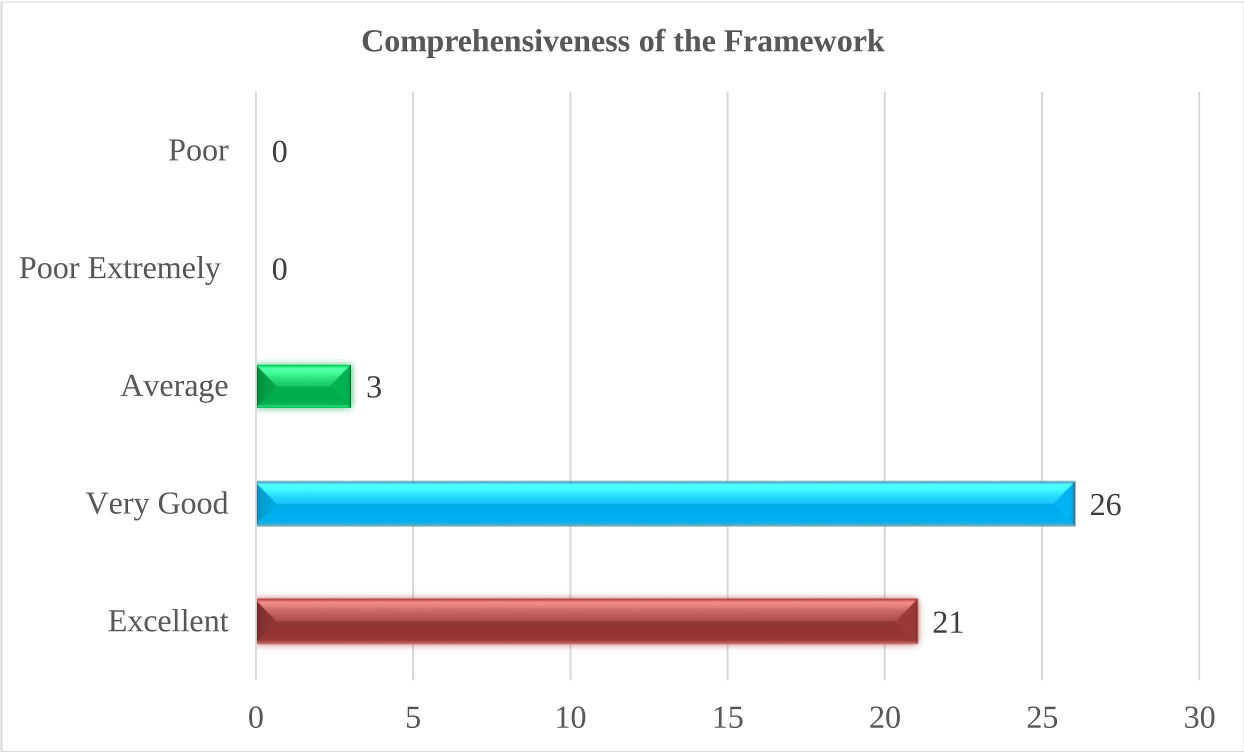

Figure 8. 3: Assessment of the Comprehensiveness of the Framework-Source (Author, 2021)

8.3.2 Qualitative Framework Assessment Response

To complement the quantitative data, some qualitative responses were also obtained from some selected experts as presented below:

i.) Project Management Expert;

"*The framework stands out so well especially that the concept of PPP is currently being appreciated. I strongly think it can yield the intended results. Ensure you engage the PPP department for consideration".*

ii) Senior Consultant in Project Financing;

"This is such an easy framework which can be adopted even in other construction projects which are finalized under PPP. The risk management concept which has been well captured on this framework applies to any other project. The risk allocation component included in the framework spices up the entire work".

iii) Consultant Project Planning;

"The notable strengths for this framework includes; it clearly outlines incorporation of risk management in a PPP construction project; Framework development in tandem with ISO 31000 principles and guidelines; and Easier to apply in a PPP Hydro Power construction Project internationally. However, the following weakness must be addressed such as symbols used not adhering to the flowcharts principles for instance Start and End symbols shown do not conform to what is recommended; Under Project Planning, need to consider the inclusion of Project Quality for consistency sake; and Instances were decision was to be passed, options not marked.

iv) PPP Expert

"Provided the above-stipulated areas of improvement were considered, the developed framework will effectively help Risk Management application in Hydro Power Construction projects involving PPP".

v) Risk Management Expert

"The involvement of Legal and Financial Advisors/ Consultants is highly important. The social-economic factors must be over warming for the project to be justified".

vi) PPP/HPP Experts

"The developed framework shows the very clear and simplified flow of project activities which enables easy planning, decision making and implementation for various activities on the project resulting in more effective time management and timely project completion. It offers a well-tailored project delivery system that would enable a hydropower project to run consistently success. It brings out the importance of project consistency and also the importance of stakeholder collaboration and teamwork during the project implementing process".

Despite, the positive responses regarding the developed framework, there was also some critical comments which may render some difficulties in the implementation of the same. These included the following factors:

(i) Risk Management Culture in the public and private sector is yet to be enhanced.

(ii) Inadequacy political will of the relevant Government Offices and specific Contracting Authorities.

(iii) In-depth understanding of the importance of the risk management process.

(iv) Thorough understanding of PPP policies and legal framework among the stakeholders.

From these points outlined above, it can be presumed that there is a need for proper stakeholder engagement and capacity building on risk management cultural and public-private partnership models. Thus, the developed framework is envisaged that it should be subjected to further scrutiny at various PPP workshops and academic environments. The developed framework has been presented as an appendix (iv) due to the size of the document.

8.4 Benefits of using the Framework

a.) The framework can be used by Project Developers, Project Financing Institutions and Contracting Authorities in a separated or integrated model of Public-Private Partnership.

b.) The framework provides a systematic approach for an in-depth understanding of the integration of the risk management process in a mega construction project finalized through PPP at the project development stage.

c.) It provides an opportunity to project stakeholders to learn and document experiences from past projects to increase capacity both at the organisational level and individual capacity

d.) Comprehensive adherence to the framework could provide a win-win situation as risk management integration could be enhanced.

e.) Numerous risk models and frameworks in the existing literature are mathematical, thus attesting difficulty for the application of the framework. However, the proposed framework created an enabling environment and easy to follow steps.

8.5 Limitations of the framework

a.) The framework is only developed for the project development stage of the project life cycle. It does not cater for the other proceeding phase.

b.) Institutions should provide an empowering organizational structure and culture to make the framework relevant.

c.) Due to the details provided on the Framework, some users may experience fatigue but once familiar with it, this can diminish.

d.) For the continuous improvement sake, this framework needs to be updated by the practitioners whenever there are any legal or regulatory changes to remain current.

8.6 Development of Risk Register

Once, the risk management activity is completed, a risk register is then developed which is in a tabular format indicating all the critical components of the process in a more systematic and presentable manner. A risk register must be a "live Environment "for the project as it has got information regarding sources of risks, risk factors, probability of the risk, impact, risk owner, risk ranking, risk significance and mitigation measures. It is a corporate tool that captures and enables a systematic approach to risk management. Project Financing Institutions and Regulatory Institution demand for this tool to be made available and forms part of the Bankable Documents/ Full Business Case. During the monitoring and review of the risk management process, the risk register is adjusted whenever the initial position of the risks recorded changes. As part of the research's output, this author has attempted to develop a risk register for HPP/PPP with inputs from the literature survey, theories and data collected from the exploratory mixed method design used. The risk register is presented in Appendix (iv).

8.7 Chapter Summary

This chapter has the proposed risk management framework and risk register for HPP/PPP. The framework components have been well elaborated on in this chapter including the methodology adopted to validate and evaluate the same. The results have also been well presented which also included the qualitative response and some challenges which may be encountered when implementing the same. There is even the need to further presenting this framework to a wider group at workshops/seminars or academic environment. It is projected that the outcomes presented in this research would assist both the public and private sectors to deliver PPP projects more successfully.

CHAPTER NINE

SUMMARY OF FINDINGS, CONCLUSION, RECOMMENDATIONS AND RESEARCH CONTRIBUTION

9.1 Introduction

This chapter presents the summary covering the salient components of the study and translates the same into a conclusion based on the research questions. It also has the suggested recommendations to fill the knowledge gap established and strive to solve the study problem. The chapter also cites some significant limitations experienced during the study. Furthermore, it highpoints the areas for further studies as one of the options to extend the research work and generic conclusion.

9.2 Summary of the Findings

The research established that improved infrastructure delivers foremost paybacks capable of achieving the value for money and sustainable goals. It was also established that economic growth is catalyzed with accessibility and availability of energy for various sectors to meet their development goals. The literature revealed that electricity is a valuable input into all sectors of the economy, thus it is an important asset for national development. Zambia has encountered a power deficit of about 800MW due to high demand. The country's energy is mostly derived from hydropower projects. And there have been some projects developed in this energy sector with the involvement of private financing creating a Public-Private Partnership, however, there are inherent risks with the potential to hinder the attainment of the objectives of the project. The complexities allied to HPP/PPP such as the technical, managerial and financial interventions during the project development to the commissioning stage accommodates greater risks. Thus, it is imperative to understand the inherent risk with innovative and rigorous risk management systems.

Accordingly, this research explored various inherent risk factors associated with HPP/PPP at the project development stage in Zambia. The literature survey enhanced the deep appreciation of the demand for energy infrastructure, the importance of risk management systems on mega construction projects, and how a well-designed risk management framework can support the minimization and elimination of risk factors that can impede project success. The project development stage of hydropower projects is a very fundamental stage that must be highly vetted and adjudged of all the inherent risks. It is envisaged that if proper identification of risks, analysis, and allocation is done at this stage, there is a high probability of recording project success and sustainable renewable energy. The research questions are fully respondent as follows;

9.2.1 What are the risks associated with Public-Private Partnership Concessions for Hydro Power Projects at Project Development Stage-Project Feasibility, Planning, and Procurement?

Given the first question, the study established that there are various risk factors associated with HPP/PPP. A total of forty-two risk indicators were identified and clustered into seven broad risk categories namely contractual risks, financial risks, economic risks, political risks, social/environmental risks, regulatory/legal risks, and technical risks for easy alignment to the project. And these risks are inherent in the various components of the project development stage, with the planning stage bearing more risks. Risk identified must be allocated to the project partners (private entity, public entity, or equal sharing) based on their knowledge and capacity to manage them. The effective allocation of the risks of HPP/PPP bears the quality of the partnership. Though the private sector gets more attracted to projects with fewer risks to manage, the research concludes that risks that are more aligned with the private sector's technical capacity must be managed by them.

The study further infers that allocating more risks to the private sector is not an economically viable decision as the cost is more on the public sector once the project is not delivered on time or abandoned due to financial risks or force majeure. Thus, equitable risk allocation is an answer. Likewise, the misallocation of risks has a highly significant correlation to the main grounds of conflicts and disputes during construction and operation phases of PPP Infrastructure projects resulting in non-attainment of Value for Money and pitiable sustainability of the project. Hereafter, well - thought out and systematic risk identification and allocation is very imperative for the successful implementation of the PPP project.

For the operationalization of the theory, this author used the lens of the Principal-Agent theory propositions to consolidate the findings on risk allocation. The theory originates from the incentive and participation constraints in the intensification agenda. This is elucidated on three anchor points; the particular partner's ability to manage risks being routed from the incentive constraint; and the risk-bearing cost differential between partners grounding its strength on the participation constraint. This author further recommends the third anchor point that was established during the data analysis stage, the support anchor. This support anchor looks at how the Principal gets involved and manage some risks for the Agent's successful progression. This is mostly for risks such as permit delays, land acquisition and regulatory risks. The third anchor is mostly for risks whose origin is either burred or ambivalent. The success of these principles lies in incorporating the same in the PPP contractual agreement. Table 9.1 summarize paucities in risk analysis based on the Principal-Agent Theory perspective. The study further deduced that most professionals managing infrastructure projects have more skill in risk identification but it becomes a challenge when it comes to risk analysis (probability of occurrence and degree of impacts/effects on the project objectives. Furthermore, risk monitoring and control is not fully established in a systematic and formalized manner.

Table 9. 1: Illumination Using Principal-Agent Theory as a Lens

Concept	Issues
Acquaintance	Information is inadequate in qualitative-quantitative risk analysis, monitoring and control of risks as per best practice guidelines. i.e ISO 31000:2018
Commitment towards PPP	Agents (private sector) are committed in a situation where there is an enabling environment and legal and regulatory frameworks are in place. However, deficits resulting from risk management are the most constraining. The absence of risk management frameworks on a project limits risk analysis.
Risk Perception	Stakeholders-Project developers, consultants, sponsors, contractors and clients perceive risk as negative. The issue regarding some positive risks is therefore hardly appreciated. This deprives the opportunity to mitigate the internal risks as the concentration is on external risks.
Interest and Power	Mostly the principal (public sector) seem to be absorbed in plummeting transaction costs such that they would use their power to transfer more risks to the Agent (private sector). However, the Agent's interest is the return on investment and use their power to abandon projects when their very existence is endangered.

9.2.2 How do the effects of the risks and the probability of occurrences affect the HPP/PPP models at the Project Feasibility, Planning, and Procurement Stage?

The deduction on the second question regarding the probability and impact of the risks on project objective is that certain risks have got a high probability of occurring and the impact is significant. While others could have a low probability of occurring but the impact is huge or vice versa. The financial, technical, geological, and environmental risks have a high probability of occurrence due to the nature of the hydropower projects. Once risks are viewed using the triple bottom line which is Plant, People, and Profit, it proves to be more significant in the assessment of the impact. The high technical capacity of the project team members and coupled with diligent geotechnical and hydrological cycle data during the project development stage proves attributes to the reduction of risk occurrence. HPP as renewable energy is not spared by climate change but also it equally mitigates climate change impacts through the water reservoirs. Mega construction projects such as HPP requires high design knowledge, competent human resource with technical skills in risk management and managerial capabilities to identify, analyze and allocate the inherent risks to mitigate the impact on the project objectives. This analysis supplements the decision-making process and provides a technical platform for additional opinions. Furthermore, for better analysis, the project team members must select the appropriate tools or techniques for the essential reliability of the results and productive use of resources.

9.2.3 What are the techniques and inputs for the risk management framework suitable for Zambia Hydro Power Projects implementation through PPP and the importance of a risk register?

Subsequently, the conclusion drawn to respond to the third research question is that designing and developing the framework for HPP/PPP must have some critical technical inputs integrated. Experience of stakeholders, institutional capacity, elements of private party appraisal and due diligence, and essentials of technical project proposal appraisal was identified as some noteworthy technical inputs into the framework The statistical analysis proved that there is a high significance of these inputs, thus justifying their importance in the development process of the Risk Management Framework and Risk Register suitable for stakeholders involved in Hydro Power Projects finalized under Public-Private Partnership.

The integration of risk management framework on a PPP model conforms to be part of a sound management practice and an indispensable element of good corporate governance. Furthermore, it increases decision-making and augments outcomes and accountability. The risk management framework must be aligned with the policy, not only is it a structured process to identify the risks but also it substantiates to be an effective mechanism for planning, pro-active management of risks, and also effective risk allocation. It further improves stakeholder confidence and trust, improved compliance with relevant legislation, and an effective monitoring and evaluation project strategy technique. The developed risk register stands as a comprehensive overview of risk information.

9.3 Recommendations

Grounding on the overall data and findings of this research, the succeeding policy recommendations are proposed with the potential to help in ameliorating or eradicating the identified risks/challenges in future HPP/PPP. The recommendations could be useful even in other mega construction projects which are finalized using the Public-Private Partnership route in Zambia. The recommendations are as follows;

i. **Risk Management Culture**

The risk management culture must be urgently developed and integrated at the project development stage of HPP/PPP. As there are a lot of identified inherent risks in HPP/PPP, thus a good risk management culture ensures that there is a conducive environment that encourages open and upward communication on risk process, sharing of advanced knowledge and best practices from the experts, possession of mindset that promotes continuous process improvement and a strong commitment to ethical and responsible business behaviour. Risk Management Culture change is a significant shift that must be promoted with adequate investment in this process.

ii. **Training & Development**

There is a need for adequate training for Project Officers/Engineers, Government Officials, Consultants, Project Developers, PPP Experts, and any other stakeholders involved in HPP/PPP to comprehend the prominence and value of managing risks for the appropriate action on the projects. Building capacity in the integration of risk management on mega construction projects will enhance the in-depth identification of the risks and uncertainties including integrating the same into the project planning. Also, the training delivers core competencies in the analysis of the identified risks and allocation to the party with wealth and capacity to manage the risk. It besides enhances base decision-making on technical information and consideration of potential risks including embracing ethical consideration.

The higher learning institutions should re-look into the risk material being delivered to the students and ensures it is in line to solve some existing project problems. It should consist of tools and techniques with practical solutions for the identification and analysis of risks. The lessons must comprise both theory and software practical's on the applications of packages such as Monte Carlos simulation, Crystal Ball Analysis, Decision Trees Analysis, Structural Equation Modelling, System Dynamics including many other packages being used on projects in developed nations.

Finally, it is expected that the training and development heighten the ability for the development of more structured mechanisms for acquiring and capturing proactive risk process knowledge including maintenance of risk registers. Training enables the project stakeholders to acquire the technical skill of transferring knowledge gained from previous projects to the current and future projects as it increases the level of PPP expertise in both the private and public sectors.

iii. Private Party Protection

It is recommended to establish adequate mechanisms to ensure that the agreements signed by the private sector and the current governments are honoured even with their predecessors. Mostly the frequent changes of government administration usually affect the signed concessions which is a pure case of political risk. Therefore, in mitigation of this political risk, the PPP department can formulate a deliberate Infrastructure Concession Policy to assure the private investment of projects of the legality and enforceability of concessions. The policy must include formulating incentives for good performance and allocating the PPP risks among the various PPP stakeholders to the parties best able to control or bear them. The protection and rewards for each of the project's stakeholders will reflect this allocation of risk. The policy must be able to give assurance to the private sector despite some possibly challenging factors, the underlying conditions are adequate and the government is committed to supporting the project's success. The policy must indicate that in an event of a Government Procurement Entity default, it must continue to make full payments to the project company between default and termination. Payments must be made in the amount that would have been payable had there been no breach and the project company had otherwise been able fully to perform

iv. Insurance of PPP Projects

The Insurance firms in Zambia must be encouraged to develop and offer some packages to specifically cover the risks at the project development stage of HPP/PPP. The insurance package could cover the feasibility component regarding the quality of the data obtained. The other package could also especially be premeditated to cover the planning and procurement components of the PPP process. The accustomed insurance package in PPP projects could cover the quality of design, tendering procedure, specifications standards, and civil liability to third parties. The other insurance cover package may include insurance against business process interruptions and force majeure (acts of God). Nonetheless, since HPP/ PPP projects are extremely complex and involve huge project financing, potential insurance firms may opt to undertake syndicate types of insurance to pool resources together.

v. Operative Stakeholder Engagement

HPP is often characterized by the displacement of the local people, resettlement projects, compensation, and public opposition including environmental liabilities. It is imperative to have high involvement of stakeholders before the commencement of the project. Thus, before and during the project execution, there should be deliberate activities of gathering and disseminating the information essential for enlightening besides educating the public on the significance of the project to be undertaken. The government and private investors must be able to purposefully identify and engage potential stakeholders who command community power and influence which can affect the smooth project execution.

Stakeholder's opposition to the projects is usually worsened where adulterated evidence of corruption and a lack of transparency in the PPP proceedings is perceived. Thus, it is recommended that the public sector must inculcate transparency and accountability in all the processes and procedures from the feasibility to the procurement stage. This builds confidence among the stakeholders to buy into the PPP projects. Furthermore, it is recommended that the government must create a legal environment for private investment through the establishment of appropriate legal and institutional frameworks. It is envisaged that this will facilitate adequate access and accurate information about the PPP project and the protection of the local cultural heritage of the affected communities.

9.4 Limitations of the Research

This study encountered some limitations that arose from the methodology, Covid 19 Pandemic, and the development of the risk management framework and risk register. This author infers that in the absence of these shortcomings, the study could have been more comprehensive and complete. Thus, the study outlines some conditions that can be cited to limit the applicability or generalization of the findings of this research to the other developing nations or other forms of PPP projects. The conditions are outlined as follows:

(i) **Methodology**: The Delphi Technique was used for identification of risk factors, risk analysis, and allocation of the risk to private, public, or sharing the same. This technique involves contacting the experts on a three-round exercise. It was realized during the second and third rounds, some experts were delayed to respond or others had completely fallen off the process. The panel experts were about 20 as per recommendations from other research done on a similar topic. Though this technique was complemented with an additional questionnaire survey, interview template, and site visits, the identification, analysis, and risk allocation of risks by 15-20 experts cannot be taken as a representative of the whole community of experts. Accordingly, this was recognized as a limitation to the study.

Furthermore, the study targeted the experts in HPP/PPP, Project Financing Institutions, and Government Officials with experience in PPP including

Academician/Consultants in project management. However, the selection of the key informants was done by a non-probability design method well-known as purposive sampling. It is wished that the identification, analysis, allocation of risks, and strategic mitigation obtained by this study could be enhanced in future research work if more experts and cases studied are considered at the global level. Additionally, the opinions and technical information obtained from the interviews could have been enhanced if a larger sample size with experience in HPP/PPP had participated. Though, this was not possible during this research as only about two HPP/PPP projects being undertaken and the PPP philosophy in Zambia is yet to be developed. Hence, this was considered as a limitation of this study.

(ii) **Covid 19 Pandemic**: The Covid 19 pandemic which started in December 2019 from Wuhan Province in China and spread worldwide at a higher rate affected this study. Some of the scheduled site visits and face to face interviews were cancelled due to some restrictions imposed by the Ministry of Health Guidelines. This compromised to some extent the quality of information obtained by using platforms such as Zoom and cellphone due to poor network and communication lagging. And on a depressing note, some potential respondents were infected and quarantined for a longer period and three (3) respondents who participated in the first round of Delphi, unfortunately, passed on due to Covid 19. It is hoped that if this pandemic did not occur, some more quality data could have been obtained. Thus, this contributed to the study as a limitation.

(iii) **Development of a Framework & Risk Register**: The developed framework and register were subjected to face validation and evaluation only for a few purposively selected experts. This author did not have enough resources to subject the same to some open workshops or seminars for further critics and validation. It is hoped that if this was done, more evaluation responses could have been received to enhance the developed framework. However, this was not done due to the second wave of Covid 19 which posed a health risk for people to assemble in a workshop or seminar and the Ministry of Health had issued restrictive measures to prevent the spreading of the virus which left this author to depend on online communication. This was considered a limitation to the study.

(iv) **Technical Experts**: The experts were drawn from various sectors which were implementing PPP and not only from the HPP. Thus, this was a limitation to some extent.

9.5 Research Contribution

Numerous contributions have been contributed to the body of knowledge by this thesis such as originality of the empirical research, innovative synthesis, different contexts, and new evidence on old issues, methodology application and uniqueness of the discipline. These are discussed as follow:

Table 2.7 and Table 2.8 in Chapter Two-Part B provide some critical scrutiny of qualitative and quantitative risk analysis techniques, limitations, and critical success factors (CSF) for effective implementation on complex construction projects. These two tables provided some fundamental platform for choosing the most suitable technique to use. This analysis was arrived at qualitatively through content analysis. The information provided illuminates the appropriate way of analyzing risks. This design provides a new synthesis of risk analysis through qualitative and quantitative methods. Current literature emphasizes the advantages and disadvantages but does not go further to recommend the critical success factors for the effective application of the techniques. This is a contribution to the body of knowledge.

The study extensively looked at the integration of Value for Money and Sustainability of the hydropower projects in the risk management framework. This is an innovative ideal as must existing literature tackles these factors independently. Section 6.12 presented statistical analysis postulating a strong positive linear correlation between the predictor variables of project outputs and the dependent variable -Value for Money and Sustainability of HPP 81.6% and 82.9% respectively. This innovative integration of the value for money and sustainability of HPP in the developed Risk Management supported by the correctional coefficient analysis is a contribution to the body of knowledge as no such literature exists in HPP/PPP in Zambia.

Climate change risk has severe impacts on hydropower projects(Nsefu et al.,2020). Thus, the developed framework has incorporated the climate change resilience measures aspect. The knowledge was presented entitled; ***Climate Resilience for Hydro Power Projects at Project Development Stage"*** during the IEK 27TH International Conference 2020 themed 'Engineering a Post Covid 19 Future'.

This study used the Contract Incompleteness Theory, Stakeholder Theory, Principal-Agent Theory and Transaction Cost Economic Theory to broaden the landscape of explanations that could be used to enlighten the repetition of risk management in Public-Private Partnership of Hydro Power Projects in the Zambia context(refer to chapter 4). The combination of these four theories which are commonly used in most business management research but now used in the development of a risks management framework for HPP/PPP is a contribution to the existing literature. There was high significance in the application of the selected theories as the author gained a new understanding of the study which was attained by looking at the earlier similar studies. Moreover, the theories used in this research deliver new evidence for an existing problem by providing observed data that brings an additional interpretation to the subject of risk management framework in HPP/PPP as elaborated in the section from 4.2.1 to 4.2.4. The Principal-Agent theory was been illuminated as a lens in this study. This is a contribution to the body of knowledge.

In chapter 6, the empirical results were extensively provided to answer the research questions not only on the risks associated with HPP/PPP but also the probability of occurrence and effect on the project objectives. It further allocated the risks to the party with the capacity to manage the risks. Most of the previous literature on the Zambian construction context did not apply this robust combined risk management process. Most literature reviewed discussed the components of the risk management process in isolation. This was a holistic approach to risks associated with complex construction projects such as hydropower projects. This is another contribution in this study as the study goes beyond risk identification but also analysis, mitigation, monitor and control.

The study further section 6.6.1 statistically tested technical inputs (Technical Project Proposal Approval, Private Party Approval and Due Diligence, Institution Capacity and Experience of

Stakeholders) to be used for the framework using multiple regression so that the selected variables used on the proposed framework have an impact. The technical inputs which were established through a qualitative analysis were further quantitatively tested for model fitting. This process enabled this author to confidently determine which technical inputs matter most, which inputs can be ignored, and how these inputs influence each. The regression model depicting R, R squared and Adjusted R was developed initially before the final framework development. This, therefore, has added the aforementioned dimensions to the argument of inputs into the framework design. This on its own was a risk assessment to ensure only technical inputs which have high significance are added. This is a contribution to the body of knowledge.

The research approach was an exploratory sequential mixed method. The qualitative approach was first applied followed by the quantitative approach. This approach enabled Triangulation. - Convergence of data from both qualitative and quantitative; offset. – Ability to offset the weaknesses of each approach taken; and Completeness. – having a more comprehensive understanding of the topic. Furthermore, Delphi Technique, Literature Survey, Interview Template and Questionnaire Survey was used to collect data. Furthermore, the developed framework was validated by panel experts drawn from various disciplines (refer to Table 8.1). The research output which was the risk management framework and risk register were arrived out qualitatively and quantitatively for easy implementation by the Project Participants, contrasting other mathematical models/frameworks that are difficult to implement. The methodology was embraced in a pragmatic worldview philosophy as the research was left open-minded to gather as much data as possible. This originality of the work is yet a contribution to the study.

The critical contribution is the development of the risk management framework specifically for the project development stage of the hydropower projects finalized through PPP. The proposed framework is to aid Project Developers, Contracting Authorities and Project Financing institutions engaged in HPP/PPP at the project development stage to minimize or eliminate inherent risks, as well as the mechanisms to effectively monitor and evaluate this strategy. It contributes to effective risk identification, analysis, allocation and use of strategic techniques for mitigation. This developed framework is not generic but responds to the challenges specifically for the project development stage; feasibility, planning and procurement. This is imperative as it reduces the probability and severity of potential project risks through early intervention. Further, it offers project stakeholders key benefits that include future asset protection, reputation management, and the optimization of construction management as established in chapter 2.

9.6 Areas for Further Research

The research findings discovered some possible directions of the areas for further research in the following areas:

i. This study was limited to Hydro Power Projects finalized through PPP. Currently, there is a high demand for private investments in other sectors of the economy such as transportation, mining, agriculture, and education. It is hoped that further research could be conducted on these other sectors followed by a comparative study across sectors. It is envisioned that if such studies are conducted, it could reveal other perceptions of risk identifications, analysis, allocation, and mitigation across sectors. It can also reveal other risk factors not brought out in this research across sectors.

ii. The study was limited to the Project Development Stage of the HPP/PPP and did not cater for the construction, completion, and commissioning stage. As stated in previous chapters one and two, a well-deigned risk management framework at the project development stage reduces and eliminates risks at the proceeding stages. Therefore, further research could be done to evaluate the impact of the risk management framework at the other stages of the project life cycle.

iii. The risk management framework developed by this study is for a generic PPP solicited by the Public sector. Another researcher possibly would develop a similar risk management framework for unsolicited HPP/ PPP projects. This is when the private sector identifies the project needs in the energy sector and requests the public sector for them to commerce the project viability assessment.

9.7 Conclusions

The demand for the growth of renewable energy is growing due to the demand possed by the leading mining industry in the North-Western Province of Zambia, the opening of the Multi-Facility Economic Zones housing various manufacturing companies, the growing real estate industry, the agro projects using modern technology and rapid growth of Small Medium Enterprises. With the population of Zambia estimated to be 17 million, there is a huge gap between the supply and demand for renewable electricity. Zambia is a land-linked country with massive water bodies and surrounded by other developing nations, it offers an excellent opportunity for private investment in hydropower projects with sustained profits for the next decades. This has been evidenced by the high demand for electricity by the neighbouring countries. However, for the Zambian government with also other competing social-economic demands exacerbated by total indebtedness which stood at USD 18.5 billion consisting of USD 11.97 billion external debt while the remainder reflected obligations by State-Owned Enterprises and contingent liabilities as of November 2020, may not have adequate budget to invest in such huge energy projects single-handedly. This has led to the promotion of private investment in the energy sector.

However, like any other huge capital investment, the construction of hydropower projects are so complex and have some inherent risks which can enable non-attainment of the project objectives. It is for this reason that the study strived to identify the risk factors, the probability of occurrence, and impact on the project objectives including the allocation of the same. This led to the development of a risk management framework and risk register for HPP/PPP. The framework illustrates the whole process of the project development stage and the integration of the risk management process while the risk register presents the risk factors, analysis, severity of the risk, risk significance, risk allocation, and mitigation measures. Lastly, the research among other recommendations encourages building a risk management culture which will aid in the deep appreciation of the risk management frameworks and strategies developed to increase the project success.

The output of this study is envisioned to assist both the private and public sectors in carrying out huge construction projects to shape a reliable risk management culture. The research has established that institutions with reliable risk management cultures are in a better position to develop systems and procedures for the enforcement and integration of risk management processes on projects. The research outputs will also be beneficial to the PPP department, Financing Institution, and Contracting Authorities during the finalization of the PPP projects as the risk allocation knowledge will ensure the roles and responsibilities are enshrined in the concessions. This information is vital for comparing with what the Transaction Advisors /PP Consultants can advise on a similar project. Finally, it is openly hoped that if these technical recommendations are put into consideration and applied on HPP/PPP, it will enhance project success, obtainment of Value for Money, and achievement of sustainable development.

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Appendix (ii)

UNIVERSITY OF LUSAKA

SCHOOL OF GRADUATE STUDIES

Dear respondent,

RE: Risk Management Model in Public-Private Partnership in Hydro-Power at Project Development Stage.

I am a student at the University of Lusaka pursuing a Doctor of Philosophy (PhD) in Project Management and due for Graduation in June 2021. It is the University requirement to undertake extensive research to fulfil the award of the PhD in the mentioned area.

Due to your worth of experience in the Public-Private Partnership, Construction, and Energy including any other related areas, you have been chosen to participate in this academic research by helping to answer the questions enclosed in this questionnaire. Please answer the questions as honestly as possible. Also, note that the research is purely academic and your concealment is highly assured. Your identity can not be disclosed if you do so throughout the interview.
Any queries or difficulties noticed please do not hesitate to forward them to my email address; kalumbunsefu@gmail.com or cellphone number(s); 0977 338564 or 0968873921.

Your collaboration in this esteem shall be highly treasured.

Yours faithfully,

Eng. Michael Kalumbu Nsefu

QUESTIONNAIRE

This questionnaire relates to the specific objectives of this study. All the questions raised will be applied towards the development of the techniques for a risk management model suitable for Zambia Hydro Power Projects implementation through PPP. I would appreciate your assistance in answering the outlined questions on the Likert scale indicated. Please tick (X) for your choice or inscribe specific answers on the spaces given.

SECTION A

1. **Which of the following best describes your organization's role in Public-Private Partnership Projects?**

   Project Finance ☐ Government Official ☐ Sponsor ☐ Regulator ☐ Policy formulation ☐ Contractor ☐ Other Specify ……………..

2. **For how long has your organization been in business?**

   <5 years ☐ 5-<10 years ☐ 10 - < 15 years ☐ 15 - < 20 years >20 years ☐

3. **Highest Academic qualification**

   High School ☐ Certificate ☐ Diploma ☐ Undergraduate Degree ☐

   Master's Degree ☐ Doctoral Degree ☐

SECTION B

For Questions B6, B7 and B8, the following scale must be used to rate your preferred answer. Use a 5 point scale, (1=strongly agree, 2=agree, 3=undecided, 4=do not agree, 5=strongly do not agree), to indicate your degree of agreement on the validity of the following questions.

B4. Rate how the listed characteristics of experienced stakeholders contribute to the development of technical inputs for a risk management model for PPP Construction - hydropower projects success

Experience of Stakeholders	RATING				
	5	4	3	2	1
Compatible levels of technical expertise.					
Common vision and objective.					
Identified pre-determined goals or outcomes for the partnership.					
Appropriate performance indicators for which data is available and collection is feasible.					
Efficient knowledge and information management.					
Cultures that embrace collaboration.					

B5. Rate how the listed features of Institutional capacity contributes to the development of technical inputs for a risk management model for PPP Construction - hydropower projects success.

Institutional Capacity	**RATING**				
	5	4	3	2	1
Transparency and accountability.					
Outcomes-based performance measurement and management.					
Contractual arrangement in place.					
Defined structural relationships.					
Favourable internal political environment.					
Well-defined procurement process.					

B6. Rate how the listed elements of Private Party Appraisal and Due diligence contributes to the development of technical inputs for a risk management model for PPP Construction - hydropower projects success.

Private Party Appraisal and Due diligence.	RATING				
	5	4	3	2	1
Financial capacity.					
Organizational cultures are receptive to the partnership.					
A focus on positive goals, positive social impact, and the public good.					
Adequate technical skills, Innovations and managerial capacity.					
Clarity and openness about collective agendas and purpose.					
Clearly defined project organization structure.					

B 10. Rate how the listed essentials of Technical Project Proposal Appraisal contributes to the development of technical inputs for a risk management model for PPP Construction - hydropower projects success.

Technical Project Proposal Appraisal.	RATING				
	5	4	3	2	1
Flexible contracts with simple, robust contract variation procedures.					
Flexibility - renegotiating outcomes based on changing conditions.					
An assured project financing stream for the duration of the partnership.					

Fully understanding the business at hand, for example, hydropower.					
Value for money- Delivery of affordable services not exceeding public provision costs.					
Integrated risk management - clear and fair risk balance.					

SECTION C

C1. Is there a very clear rationale for PPP decisions at the Project Development Stage that includes the following :

a. Value for Money (VfM) analysis, (Yes/No)…………….

b. Public Sector Comparator (PSC) assessment, (Yes/No)…………….

c. and sustainability analysis. (Yes/No) ………………..

C2. How can PPP hydropower projects integrate climate change?..........................

C3. Do you agree that a well-designed risk management model can contribute to the successful completion of the PPP Construction Project by achieving the following attributes?

SN	Successful completion of the PPP Project	Rating				
		Undecided/ Neutral	Not Agree	Agree	Strongly Agree	Exceedingly Agree
		1	2	3	4	5
		(√)	(√)	(√)	(√)	(√)
1	On Scope					
2	On-Time					

3	On Budget					
4	On quality					
5	Satisfaction of stakeholders					

C4. Do you think a well-designed Risk Management Model can contribute to the achievement of Value for Money on PPP hydro projects?

SN	Rating				
	Undecided/ Neutral	Not Agree	Agree	Strongly Agree	Exceedingly Agree
	1	2	3	4	5
	(√)	(√)	(√)	(√)	(√)
1					

Give the reason for your response…………………………………………………………...

C5. Do you think a well-designed Risk Management Model can contribute to the attainment of sustainability on PPP hydro projects?

SN	Rating				
	Undecided/ Neutral	Not Agree	Agree	Strongly Agree	Exceedingly Agree
	1	2	3	4	5
	(√)	(√)	(√)	(√)	(√)
1					

Give the reason for your response…………………………………………………………...

C6. Do you agree that the following factors if effectively integrated contribute to the achievement of Value for Money and Sustainability on PPP hydro projects? Please insert either of the following feedback; Yes, No, Somehow, Not sure.

Variable	Experts Opinion
Participants' ability and Characteristic (Innovation, Skills and expertise, excellent buildability, and maintainability).	
Consumers' demand achievement (Optimal use of the asset and Output-based specification)	
Cooperation of public and private (Complementary advantages of PPP, Efficient risk allocation)	
Cost and effectiveness (Performance-based payment mechanism and Low project life-cycle cost)	
Cooperative environment (Environmental consideration, Stable macroeconomic condition, and Favorable legal framework)	
Timely completion of the project (within the stipulated project time or grace period)	
Quality of the works (Aesthetic and Service delivery on time)	

The End

Appendix (iii)

UNIVERSITY OF LUSAKA

SCHOOL OF GRADUATE STUDIES

Dear Sir/Madam,

RE: Risk Management Framework in Public-Private Partnership in Hydro-Power at Project Development Stage.

The above research has been exploring risk factors inherent in Hydro Power Projects financed through Public-Private Partnerships. It is specifically looking at the project development stage (feasibility, planning and procurement). Zambia has embraced private sector participation in energy infrastructure with recent examples being Itezhi –Tezhi and Batoka Hydro Projects. One of the research objectives seek; *to develop techniques for a risk management framework suitable for Zambia Hydro Power Projects implementation through PPP*.

This research has since developed a comprehensive framework depicting the integration of risk management in the process. Thus, your assistance in sparing approximately 25 minutes to share your valuable knowledge and experience by face validating and evaluating the attached instrument will be highly appreciated. This research is purely academic and your concealment is highly assured. Your identity can not be disclosed if you prefer so.

Any queries or difficulties noticed please do not hesitate to forward them to my email address; kalumbunsefu@gmail.com or cellphone number(s); 0977 338564 or 0968873921.

Yours faithfully,

Eng. Michael Kalumbu Nsefu

(PhD. Candidate)

SECTION A: GENERAL INFORMATION

1. **Name of organization** (optional)………………………………………………......................

2. **Type of Establishment**: Consulting ☐ Private Sector ☐ Public Sector ☐

   Financing ☐ Others specify………………………….

3. **Highest Academic Qualification**: BA ☐ BSc ☐ MA ☐ B.Eng. ☐
   MSc ☐ MEng ☐ PhD ☐

4. **Designation of Respondent in the establishment**: Director ☐
   Project Manager ☐ Financial Adviser ☐ Contractor ☐ Project Sponsor ☐

   Government Officer ☐ Consultant ☐ Others (specify)…………..

5. Have you been involved in any project executed under a public-private partnership arrangement?

   Yes ☐ **No** ☐

SECTION B: FRAMEWORK VALIDATION

6. Please tick kindly (√) as appropriate to indicate your overall assessment of the framework in terms of the following specific statement using the scale.

Excellent	**Above Average**	**Average**	**Below Average**	**Extremely Poor**
5	**4**	**3**	**2**	**1**

6. Please kindly identify the strengths and weaknesses (if any) of the developed framework.

   a.) Strengths

....

....

....

   b.) Weaknesses/ Limitations

………………………………………………………………………………………………

………………………………………………………………………………………………

…………………………………………………………………………………………………

7. Please kindly give any technical or generic remarks on the developed framework

....

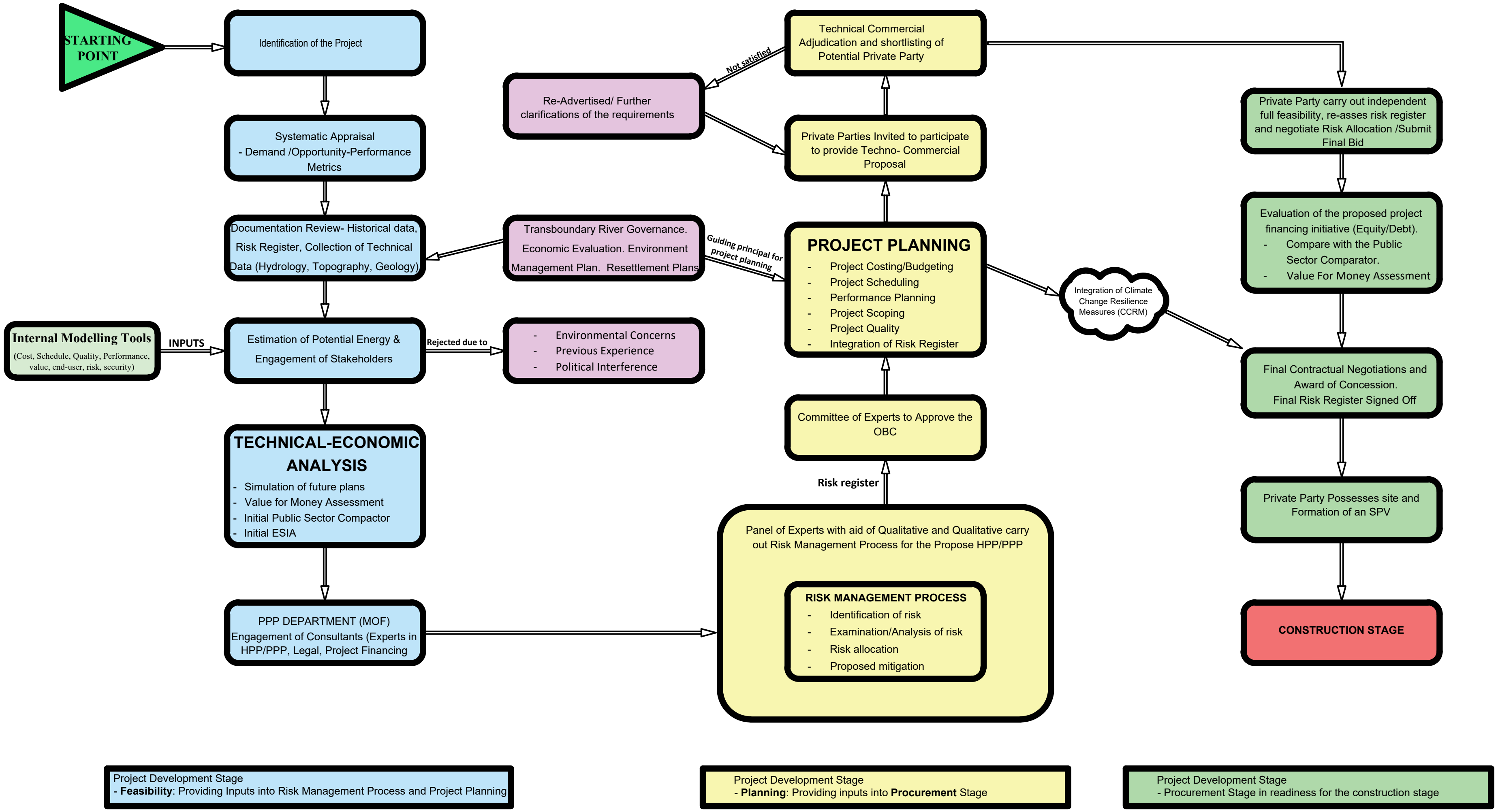
....

....

***Thank you for sparing your time*.**

APPENDIX IV

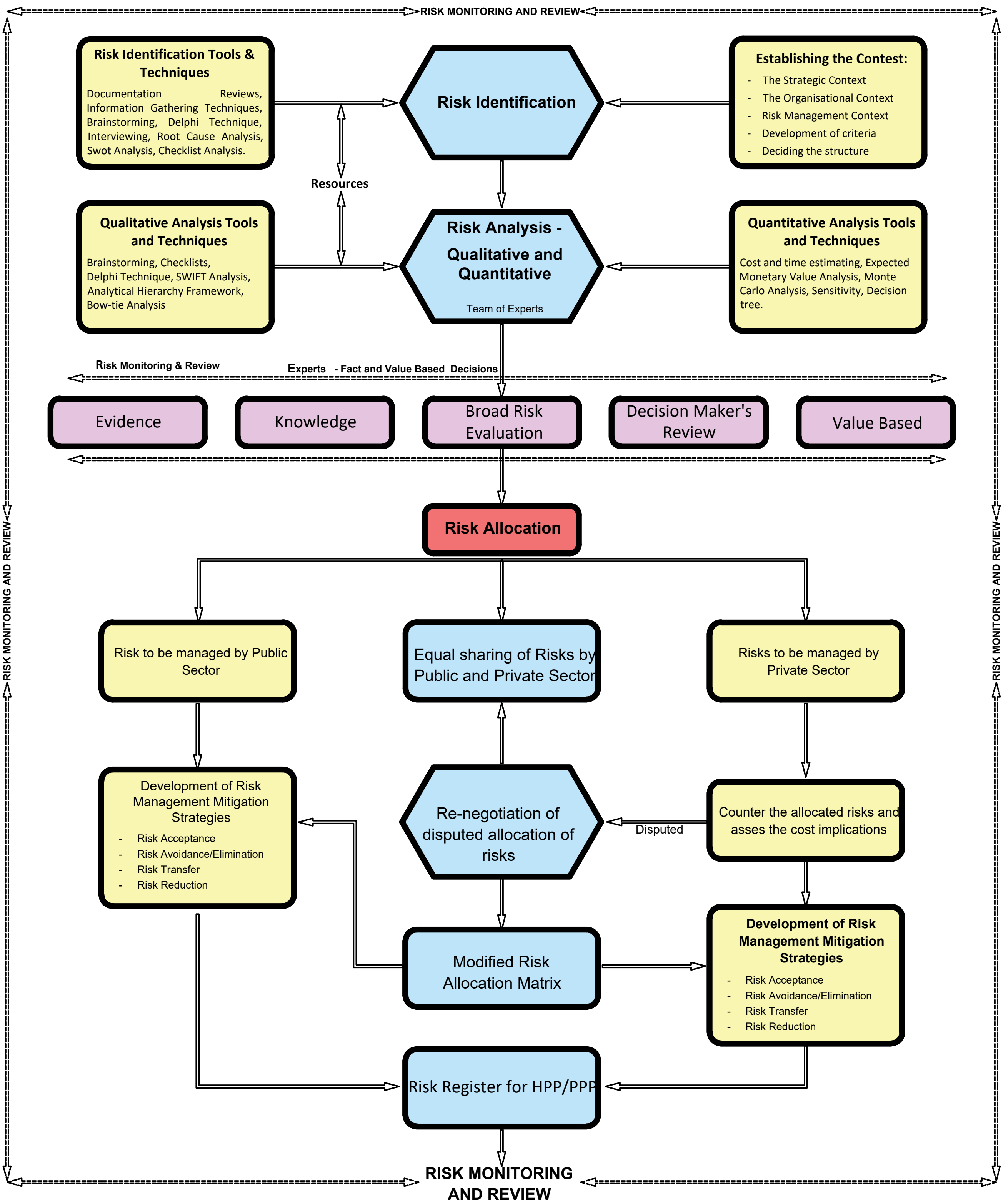
FIGURE 1: RISK MANAGEMENT FRAMEWORK FOR HYDRO POWER PROJECTS FINALIZED THROUGH PUBLIC PRIVATE PARTNERSHIP



Source: Author (2021)

APPENDIX V

FIGURE 2: Risk Management Process



Source: Author (2021)