FACTORS AFFECTING THE EFFECTIVENESS OF AYSHA WIND ENERGY GENERATION CONSTRUCTION PROJECT

A Research Paper Submitted to Addis Ababa University School of Commerce (AAU-SOC) in partial Fulfillment of the requirements for Masters of Arts Degree in Projects Management

By Dawit G/Egziabher Tekle
Email: davidmekelle@gmail.com

Thesis Advisor: Fesseha Afewerk (Ast. Professor)

Addis Ababa University School of commerce

Addis Ababa, Ethiopia

September, 2019

DECLARATION

I, the undersigned, hereby declare that the work contained in this thesis is my own original work and that I have not previously in its entirety or in part submitted at any university for a degree.

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ABSTRACT

Energy generation construction projects in Ethiopia are affected by so many factors. So, the objective of this paper is to identify the factors affecting the effectiveness of Aysha wind energy generation construction project; and to elicit perceptions of the key project participants towards the relative importance of the factors. A comprehensive literature review was deployed to generate a set of factors believed to affect the effectiveness of a project. Consequently, 36 factors categorized in to 7 groups were identified and based on these factors a questionnaire was prepared. At the end of the questionnaire, explanatory questions were added in order not to block the respondents from explaining their perceptions freely with their own words. The total population of the project is 45. So a total of 45 questionnaires were distributed to the 3 key groups of project participants; namely owners, consultants and contractors. The perception of these participants towards the factors was rated using the relative importance index method (RII) and ranked. Moreover Kendall's coefficient of concordance method (W) was used to analyze the degree of agreement in rating among the 3 key groups of project participants. The survey findings indicate that all the 3 groups agree that the most important factors affecting the effectiveness of Aysha wind energy generation construction project are: tendering method, Economic environment, Procurement method, contractor's cash flow, client's ability to make decision, overall managerial action, control subcontractor's works, contractor's experience, supervision and involvement of subcontracting, and site management. Based on these findings the paper recommends that (1) the owner should secure the finance properly before starting construction of the project. (2) Before procurement processes are started, the design and specification processes should be carefully analyzed and completed in order to avoid design changes from the beginning. (3)The main contractor should take the full responsibility of the entire construction project than transferring some risks to subcontractor.

Keywords: *Factors affecting effectiveness, effectiveness of projects, energy generation construction projects, construction projects.*

ACKNOWLEDGEMENTS

During the course of this research work, many colleagues and friends have contributed greatly and I would like to take this opportunity to thank them all.

First and for most I would like to thank my wife Nigisti Alemseged without her day to day encouragement and support It would not be possible to accomplish this paper. I would also like to express great thanks to my Advisor Ast. Professor Fesseha Afewerk for his inspirational guidance, consistent patience, encouragement and constructive criticism. My sincere thanks also goes to my examiners Dr. Dereje and Dr. Abraraw Chane who offered me their constructive criticism during my presentation of this thesis. Next I would like to thank all the people who willingly and genuinely completed the questionnaire.

Last but not least, I thank Addis Ababa University School of Commerce and its entire staff for giving me the chance to study the program that offered me invaluable knowledge and experiences.

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CHAPTER ONE

INTRODUCTION

1.1.BACKGROUND OF THE RESEARCH

Construction industries are industries, which contain planning of project work, Scheduling of project duration, organizing, evaluating, executing project progress and observing of all project works (Desalegn, Jayeshkumar, & Anand, 2018).The Structural organizations such as infrastructures, communication and energy-related construction works, water supply & disposal construction work etc., are some of the works to be performed in construction industry (Desalegn *et. al* 2018). The construction industry is complex in its nature because it comprises large numbers of parties as owners (clients), contractors, consultants, stakeholders, and regulators. Despite this complexity, the industry plays a major role in the development and achievement of society's goals. In this research the energy generation construction project works in Ethiopia will be taken in to consideration as it is one discipline of the construction industry. The study will first highlight the current energy situation in Ethiopia and then goes to brief the necessity of the research in focus.

Ethiopia has abundant renewable energy resources and has the potential to generate over 60,000 megawatts (MW) of electric power from hydroelectric, wind, solar and geothermal sources. As a result of Ethiopia's rapid GDP growth over the previous decade, demand for electricity has been steadily increasing. Despite Ethiopia's huge energy potential, the country is experiencing energy shortages as it struggles to serve a population of over 100 million people and meet growing electricity demand which is forecast to grow by approximately 30% per year. Ethiopia's Growth and Transformation Plan (GTP) outlines a 15-year plan with three 5-year phases to transform Ethiopia from a developing country to a middle income country by 2025. Under GTP I (2010-2015), the goal was to increase the installed generation capacity from 2,000 MW to 10,000 MW. However the country currently has approximately 4,500 MW of installed generation capacity. Under GTP II (2015-2020) the goal was to increase installed generation capacity by an additional 5,000 MW by 2022 (Country Commercial Guide Ethiopia-Energy, 2018).The Government of Ethiopia has focused on the construction and expansion of various power generating projects to deliver reliable electricity to achieve the goal. However the construction of the

energy generation projects couldn't be effective. One of these projects is Aysha wind Energy generation construction Project.

In this research, energy generation construction project is contextualized to mean projects constructed to generate electricity from renewables and transmitted through power transmission lines and distributed throughout the country.

1.2.PROBLEM STATEMENT

A construction project is commonly admitted as successful, when it is completed on schedule, within the agreed budget, with the highest quality and in the safest manner, in accordance with the specifications and to stakeholders' satisfaction (Tsegay, &Luo, 2017; Worku & Jha, 2016; Thote, Shinde &Kanase, 2017). However practically in most of the construction projects at least one of these success factors fail. To illustrate Energy generation construction projects in Ethiopia considering schedule as one of the success factor, Gibe III hydropower project began its construction in December 2007 and was planned to complete in 2011. However the project was actually completed in August 2016 which means that the project has faced time overrun of five years. Tekeze hydro power project begun its construction in June 2002 and was inaugurated in November 2009 with time over run of one and half years. If we consider Ashegoda wind energy generation construction project, contractually it was agreed to finalize in three year time. However it was completed with a one year time over run (EEP project report, 2018). If we consider Aysha wind energy generation project, the construction was commenced on February 25, 2017 to complete the project within two years. However in July 2019, only 43% of the project was completed though more than five months of time over run have been counted from the agreed completion time (Aysha WFP consultant monthly progress report, July 2019). These projects are raised for demonstration only. But the effectiveness of most of the energy generation construction projects in Ethiopia are affected. So what are the main factors affecting the effectiveness of energy generation construction projects in Ethiopia? What is the case in Aysha wind Energy generation construction project? This is the research question to be studied.

1.3. BACKGROUND OF AYSHA WIND ENERGY GENERATION CONSTRUCTION PROJECT

Aysha Wind Energy Generation Construction Project (120 Megga Watt capacity) is one of the renewable energy and environmental friendly projects in Ethiopia. The Government of Ethiopia (GoE) is investing by large on such fast track green projects to fill the short and long-term modern energy supply. The Employer (owner) of the project is the Ethiopian Electric Power (EEP) and the contractor is Dongfang Electric International Corporation (DEC) from China as EPC turn-key contract project in which the feasibility, design and construction of the project are all executed by the same company. The contract agreement for the project development has been signed on January 15, 2016 with contract sum of 257,285,160 USD that consists of 15% as advance payment in local currency (ETB) from EEP and 85% in USD a loan from China EXIM bank. The commencement date of the project was on February 25, 2017. The scope of the project includes: Designing, Manufacturing, Transportation, Construction, Interfacing, Testing and Commissioning. The consultant service for Aysha Wind Power Project is carried out by in-house capacity consisting of professionals experienced in previous wind power projects and substation and transmission line projects in which all are brought together and structured in EEP Engineering. EEP Engineering has signed a contract agreement with Aysha Wind Project Office on July 2016 to be Consultant (Employer Representative) for the project implementation.

According to the contract agreement, it was planned to complete construction of the project in two years' time from the commencement date. However in July 2019, only 43% of the project was completed though more than five months of time over run have been counted from the agreed completion time (Aysha wind energy generation project consultant monthly progress report, July 2019). The location of Aysha wind energy generation construction project site is located in Annex1.

A number of factors may be identified as contributing to the ineffectiveness of implementation of Aysha wind energy generation construction project. So what are the critical factors that affect the effectiveness of Aysha wind energy generation construction project? What mitigation measures are needed to be taken to avoid or at least to minimize

the ineffectiveness of implementation of the project? This study intends to identify those factors and their influence on the effective implementation of the project.

1.4.RESEARCH OBJECTIVES

1.4.1. GENERAL OBJECTIVES

The aim of this research is to identify the critical factors affecting the effectiveness of Aysha wind energy generation construction project and then looking at the mitigation measures needed to be taken.

1.4.2. SPECIFIC OBJECTIVES

1. To identify the possible factors affecting the effectiveness of energy generation construction projects.
2. To recognize the critical factors affecting the effectiveness of Aysha wind energy generation construction project in the perception of owners, consultants and contractors.
3. To analyze statistically the degree of agreement among raters (owners, contractors and consultants) in rating the factors affecting the effectiveness of the project.

1.5.RESEARCH QUESTIONS/ HYPOTHESES

1.5.1. RESEARCH HYPOTHESES

Null hypothesis: H0: There is insignificant degree of agreement in rating the factors of effectiveness among owners, contractors and consultants.
Alternative hypothesis: H1: There is a statistically significant degree of agreement in rating the factors of effectiveness among owners, contractors and consultants.

- If the W Statistic is 0, that means everyone ranked the list differently (or randomly).
- If the W Statistic is 1, then everyone ranked the list in exactly the same order.

1.5.2. RESEARCH QUESTIONS

The following research questions will be answered through the analysis of the quantitative data collected and from the responses of the explanatory questions raised in the questionnaire.

1. What are the factors affecting the effectiveness of energy generation construction projects?
2. Which factors do critically affect the construction of Aysha wind energy generation construction project?
3. To what extent do the owners, contractors and consultants of Aysha wind energy project agree in rating the factors affecting the effectiveness of the project?

1.6.SIGNIFICANCE OF THE STUDY

Practically in most of the construction projects at least one of the success factors fail. In developing countries including Ethiopia the failure become more significant especially in the energy-related sector as its contribution is irreplaceable in playing a crucial role in sustaining country's rapid and equitable socio-economic development and changing the livelihood of millions of people. So focusing the study on energy-related construction industry is substantial and timely. Aysha wind energy generation construction project is currently in progress. As the project is under construction, the respondents could be addressed easily at the project site in Aysha and in project office in Addis Ababa. Later on the end results of this study will have noticeable contribution to mitigate the factors affecting the effectiveness of the project.

1.7.SCOPE OF THE STUDY

The scope of the study include all the owners, contractors, subcontractors and consultants that participated in the construction of Aysha wind energy generation construction project. The total population of those parties is around 45 (As per the consultant report of July, 2019). The study could be applied to any energy generation construction project having similar situation. However, due to time and other resource constraints, the scope of the research is limited to Aysha wind energy generation construction project as a case study.

1.8.LIMITATION OF THE STUDY

The study could be applied in additional numbers of projects with more numbers of contractors and consultants to make the study more reliable. However due to time and resource constraints, the study is limited to Aysha wind energy generation construction project only and the population size is 45 all taken in to consideration.

1.9.DEFINITION OF TERMS

Construction industries - are industries, which contain planning of project work, Scheduling of project duration, organizing, evaluating, executing project progress and observing of all project works (Desalegn, Jayeshkumar &Anand, 2018).

Energy generation construction projects – are projects constructed for the generation of electric power (operational definition). In this paper "energy generation construction projects" and "power generation construction projects" are used interchangeably.

EPC-turnkey contract- Engineering, Procurement and Construction (EPC) is a type of contract in which the feasibility, design and construction of the project are all executed by the same company.

Independent Power Projects (IPPs) - are defined as power projects that mainly are privately developed, constructed, operated, and owned; have a significant proportion of private finance; and have long-term power purchase agreements (PPAs) with a utility or another off-taker.(Eberhard, Gratwick, Morella, &Antmann, 2016).

1.10. ORGANIZATION OF THE STUDY

This study is organized in five chapters. Chapter one provides background on factors affecting the effectiveness of energy generation construction projects in Ethiopia, statement of the problem, research objectives, and research questions that the study looks forward to answer, significance of the study, scope and limitation of the study. It also provides definitions of significant terms used in the study and organization of the study. Chapter Two summarizes the various studies (literature review) on factors influencing the effectiveness of construction projects. The theoretical, empirical and conceptual reviews are carried out. The discussions were based on the research objectives. Chapter three outlines the research design and methodology that was used for purposes of completing the study. It also describes research design, target population, sample, sampling procedure, data collection instruments, data collection procedures, and data analysis techniques. Chapter four covers data analysis and presentation of results, while Chapter five presents the summary of major findings, discussion of the findings, conclusions and recommendations of the study.

CHAPTER TWO

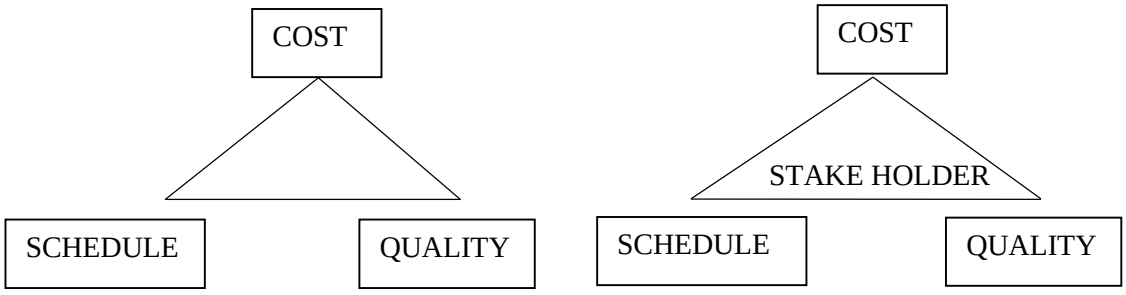
LITERATURE REVIEW

2.1. INTRODUCTION

This Chapter presents review of related theories in project management; review of previous literatures focusing on the factors affecting the effectiveness of construction projects in general and energy generation construction projects in particular; and the conceptual framework derived.

2.2. THEORETICAL REVIEW

A successful project is one that is delivered on time and managed within the budget. Time, cost and quality have been recognized as "triple constraint" or important elements of project success. The study of project success and critical success factors (CSFs) is often considered as one of the vital ways to improve the effectiveness of project delivery (Rubin &Seeling, 1967). The study of project success/failure and critical success factors (CSFs) are the means of understanding and thereby improving the effectiveness of construction projects. Early known main criteria for success were assumed to be cost, schedule and quality.



Iron triangle of project management Golden triangle of project management

Figure 1 Iron versus golden triangle of project management (Source: Babu &Dr. Sudhakar, 2015)

The iron triangle of project management emphasizes the relationships among cost, schedule and quality. The golden triangle of project management emphasizes the relationships among cost, schedule, quality and people (stake holder) by placing stake holder at the center of the iron triangle (Figure 1). The emphasis on people in the golden

triangle helps maintain a balance among cost, schedule and quality (Iyer &Jha, 2005). Later more potentially competing criteria like the satisfaction of all stakeholders, safety and design specification were defined. The more advanced definition is that "A construction project is commonly admitted as successful, when it is completed on schedule, within the agreed budget, with the highest quality and in the safest manner, in accordance with the specifications and to stakeholders' satisfaction". (Tsegay &Luo, 2017; Worku & Jha,2016; Thote, Shinde, &Kanase, 2017).

2.3. EMPIRICAL REVIEW

Researches on project success show that it is impossible to generate a universal checklist of project success criteria suitable for all projects. Success criteria will differ from project to project depending on participants, scope of services, project size, and sophistication of the owner related to the design of facilities, technological implications, and a variety of other factors.

Various researchers have taken interest in identifying and studying the critical factors affecting the effectiveness of construction projects. Chan, Scott and Chan, (2004) studied factors affecting the success of construction Projects. The aim of their research was to conduct a thorough review on literature related to CSFs in seven major management journals. As per their study, Project-related factors, project procedures, project management actions, human related factors, and external environment were identified as crucial to project success.

Helen, Emmanuel, Lawal, and Elkanah (2015) evaluated the factors influencing the performance of construction projects in Akure, Nigeria. A questionnaire survey was conducted and forty six (46) factors were identified, categorized into eight (8) groups, evaluated and ranked according to participants' perspectives. The identified factors were the same as the factors identified by Chan, Scott and Chan, (2004) described above. However the human related factors identified by Helen *et al.* (2015) was split in to three components as client related factors, contractor related factors and consultant related factors. At last, they identified top ten significant factors influencing the performance of construction projects in Akure, Nigeria with maximum score of the respondents. The factors are Escalation of material prices, Insufficient supply of materials, Motivating skills

of the project team leader, Quality control of materials, Consultants commitment to ensure construction work is done according to specification, Delay of progress payment, Project team leaders experience, Technical skill of the project team leader, Overall management actions and Economic environment.

It can be seen from the following studies that the factors used by the researchers were not out of the factors identified in the above studies although the results differ based on the projects under study.

Kiara, (2013) studied the determinants that influence the implementation of Infrastructure development projects in renewable energy sector in Kenya taking kenya electricity generating Company limited as a case study. Kiara concluded that Technology and Environmental factors are the most determinant factors.

Tsiga, Emes, & Smith (2016) studied to identify critical success factors for the construction industry. They reached in to conclusion that Project Organization, Project Manager Competence, Project Risk Management, Project Team Competence and Requirements Management respectively are the critical success factors in construction industry.

Enshassi, Mohamed, and Abushaban (2009) made research to identify the top ranked factors affecting the performance of construction projects in the Gaza Strip. As per the research, the construction stake holders agreed that the most important factors affecting project performance are: delays because of roads closure leading to materials shortage; unavailability of resources; low level of project leadership skills; escalation of material prices; unavailability of highly experienced and qualified personnel; and poor quality of available equipment and raw materials.

(Ikejemba, Mpuan, Schuur &Hillegersberg, 2017; Nyangwara, and Datche, 2015) identified the main factors affecting the performance of construction projects using Survey of Construction Projects in the Coastal Region of Kenya. They concluded that the top ranked factors are Average delay in claim approval and payment approval owner to contractor; Availability of resources as planned through project duration; Leadership skills for project Manager /Owner; Escalation of material prices; Availability of personals with high experience and qualification; Quality of equipment and raw materials in project.

The above studies demonstrate that there is a plenty of factors with the potential to affect the different dimensions of project performance. As such, this paper builds upon the vast amount of published studies (*Journal Of Project Management World 2013*; *Journal of Civil Engineering and Management* 2009; *International Research Journal of Engineering and Technology* 2018 *International Journal of Civil Engineering, Construction and Estate Management* 2015; *International Journal of Scientific and Research Publications* 2015; *Journal of Civil, Construction and Environmental Engineering 2016*) in order to identify a comprehensive list of factors affecting the performance of construction projects. Even though the lists identified are applicable to any construction project, the lists are carefully adopted to be applied specifically to power generating construction projects in Ethiopia. Subsequently 36 factors grouped in to 7 categories were refined as summarized in the table below with their respective references.

No.	Factors	References
1	**Project characteristics related factors** 1.1.Type of project 1.2.Nature of project 1.3.Complexity of the project 1.4.Size of the project 1.5.Completion period given for the contract	Chan, P.C.,Scott, D. and Chan, P.L.,2004 Yong,Y.C., and Mustafa, N.E.,2011. Odesola, I.A., Otali, M. and Ikediashi, D.I.,2013. Bendale, M., & Bhangale, P., 2018
2	**Project procedure** 2.1.Tendering method 2.2.Procurement method	Enshassi, A., Mohamed, S. and Abushaban, S. 2009; Chan, P.C.,Scott, D. and Chan, P.L.,2004.
3	**External Environment Factors** 3.1.Economic Environment 3.2.Social Environment 3.3.Physical Environment 3.4.Industrial relations 3.5.Technology advancement	Kiara, C.K., 2013; Chan, P.C. Scott, D. and Chan, P.L., 2004.

4	**Client related factors** 4.1.Client's experience 4.2.Client's ability to brief 4.3.Client's ability to make decision 4.4.Client's knowledge of construction project organization 4.5.Client confidence in the construction team 4.6.Technical skills of project team leaders 4.7.Motivating skills of project team leader	Tsiga, Z., Emes, M. & Smith, A. 2016; Enshassi, A., Mohamed, S. and Abushaban, S. 2009; Ikejemba, E., Mpuan, B., Schuur, P., Hillegersberg, J. 2017; Nyangwara P.O., and Datche E. 2015; Helen, B.I., Emmanuel, O.,Lawal, A. and Elkanah A. 2015; Yong,Y.C., and Mustafa, N.E.,2011
5	**Contractor related factors** 3.1.Contractor's experience 3.2.Site management 3.3.Supervision and involvement of subcontracting 3.4.Contractor's cash flow 3.5.Effectiveness of cost control system 3.6.Speed of information flow	Enshassi, A., Mohamed, S. and Abushaban, S.2009; Ikejemba, E., Mpuan, B., Schuur, P., Hillegersberg, J. 2017; Nyangwara P.O., and Datche E. 2015; Helen, B.I., Emmanuel, O.,Lawal, A. and Elkanah A. 2015; Yong,Y.C., and Mustafa, N.E.,2011
6	**Consultant related factors** 6.1.Consultant's commitment to ensure construction work is done according to specification 6.2. Consultant's involvement to monitor the project progress 6.3. Consultant's cooperation to solve problems.	Helen, B.I., Emmanuel, O.,Lawal, A. and Elkanah A. 2015; Yong,Y.C., and Mustafa, N.E.,2011
7	**Project management factors** 7.1.Communication systems 7.2.Control mechanisms	Tsiga, Z., Emes, M. & Smith, A. 2016; Helen, B.I., Emmanuel, O.,Lawal, A. and

	7.3.Feedback capabilities 7.4.Implication of an effective quality assurance 7.5.Overall managerial actions 7.6.Control of subcontractor's works 7.7.Developing appropriate organizational structure 7.8.Implementing effective safety system.	Elkanah A. 2015; Yong,Y.C., and Mustafa, N.E.,2011.

Table 1 summary of factors with their corresponding references

N.B. the terms "energy generation construction projects" and "power generation construction projects" are used interchangeably in this context to refer to the projects constructed to generate electric power.

2.4. CONCEPTUAL FRAMEWORK

Careful study of the previous literatures suggest that the factors affecting the effectiveness of energy generation construction projects can be grouped in to 7 main categories. These include Project characteristics related factors, project procedures, external environment factors, client related factors, contractor related factors, consultant related factors, and project management factors. These factors are believed to affect the success of a project. Let's see their effect on project success one by one.

1. **Project characteristics related factors –** the characteristics of one project does not fit all. It depends on many attributes as type of project, nature of the project, complexity of the project, size of the project and completion period given for the contract.

   Complexity: complexity of the project is associated with difficulties in decision making and goal attainment. The complexity of a project, along with the level of uncertainty is the characteristic most commonly associated with Major projects. Complexity is compounded by uncertainty; Project complexity is the source of uncertainty in projects. The larger the size and complexity of the project; the more uncertainties and risks in all its form surround it. (Bendale & Bhangale, 2018).

Size of project: If the size of the project is large, the limited number of project people may not be able to do justice in all areas and this may adversely affect the project quality. (Bendale & Bhangale, 2018).

The effect of the type of project and nature of the project on project success is demonstrated along with the external environmental factors described on number 3 below.

Completion period given for the contract: The completion period given for the contract directly affect the success of the project. The time required for the construction of the project should be studied and analyzed carefully. If a shorter completion period than required is given, the contractor will only focus on materials that could save time without considering their quality. This will affect the project success as it will not be constructed based on the design specification, safety and to the quality that satisfy the customer.

2. **Project procedure related factors –** many researchers have recognized the significance of project procedure related factors. The two attributes used to measure this factor are tendering method and procurement method. **Tendering method** are the procedures adopted for the selection of the project team particularly the main contractor; and **procurement method** are selection of the organization for design and construction of the project (Chan, Scott and Chan, 2004; Helen *et. al*, 2015). Tendering is the function that costs an organization a great deal of money and this has to be performed correctly in order to maximize effectiveness and minimize costs. Procurement is often carried out by the process of tendering. The accepted objectives of tendering and procurement procedures are to ensure that works are executed at the minimum cost that is consistent with the need to achieve a product of acceptable quality within an acceptable timeframe.

3. **External Environment Factors –** various researchers have recognized "environment" as one factor affecting project success. The attributes used to measure this factor are Economic environment, social environment, physical environment, industrial relation environment and level of advancement of technology (Chan, Scott and Chan, 2004; Helen *et. al*, 2015).Project success is dependent on key factors within the environment that directly impact on the project.

Construction projects interfere with so many things within the natural environment such as **Social Environment** (People and communities within the project environment) and **Physical environment** (physically existing things such as buildings, trees and so on), and this is what leads to resistance when the development of a new construction project is initiated. The resistance first comes from the people who live close to the site. These people will be directly affected by the project and thus they will suffer more if the project comes into existence. Therefore, the developer should choose a site with minimum impact on the social and physical environment as this will reduce the costs of balancing nature and cost of mitigation actions on the social environment such as compensation costs for the people impacted by the project. (Abraham, 2010).

Since each and every project has its own impacts on the people around it and the natural and built environment, the effects depend on the nature of the project itself and the magnitude of activities that take place during the project.

The **economic environment** will also affect the construction of the project as it will impact on the kind of materials that will be used in the construction of the project. This will also in turn affect the level of advancement of the technology used for the construction of the project. The site itself will dictate which type of project can be constructed at the site. The available technology will dictate how the project will be constructed and how fast it can be constructed (Abraham, 2010).

4. **Client related factors** – many client related factors are described in various researches as main factors affecting the effectiveness of construction project. These include attributes like client's experience, client ability to brief, client's ability to make decision, client's knowledge of construction project organization, client confidence in the construction team, technical skills of project team leaders and motivating skills of project team leaders (Helen *et. al*, 2015).

5. **Contractor related factors –** several researches have also identified that the contractor and subcontractor play vital role in the effectiveness of construction projects. These attributes include contractor's experience, site management, supervision and involvement of subcontracting, contractor's cash flow, effectiveness of cost control system, and speed

of information flow. These factors have strong correlation with the success of the project (Helen *et. al*, 2015).

6. **Consultant related factors –** the characteristics related to consultant are commitment to ensure construction work is done according to specification, consultant's involvement to monitor the project progress, and consultant's cooperation to solve problems. These factors have great effect on the project success (Helen *et. al*, 2015).

7. **Project management factors –** as in many researches, project management actions are key for project success. The variables in project management include communication systems, control mechanisms, feedback capabilities, implication of an effective quality assurance, overall managerial actions, controlling of subcontractor's works, developing appropriate organizational structure, and implementing effective safety system (Chan, Scott and Chan, 2004; Helen *et. al*, 2015).

   In this study, the factors obtained from review of literatures will be used as a base line to build the questionnaire for collecting data. The survey will target on project owners, consultants and contractors, to find out how each project party perceives the relative importance of these factors. Finally the research will formulate a number of recommendations based on the data collected through the questionnaires in order to bridge the gap between the different perceptions thus improving the level of project performance when constructing power generating projects. After the conclusions are drawn, corresponding recommendations will be suggested. These conclusions and recommendations will be used as the mitigation measures needed to be taken to avoid or at least to minimize the influence of the critical factors that affect the performance of the project under study.

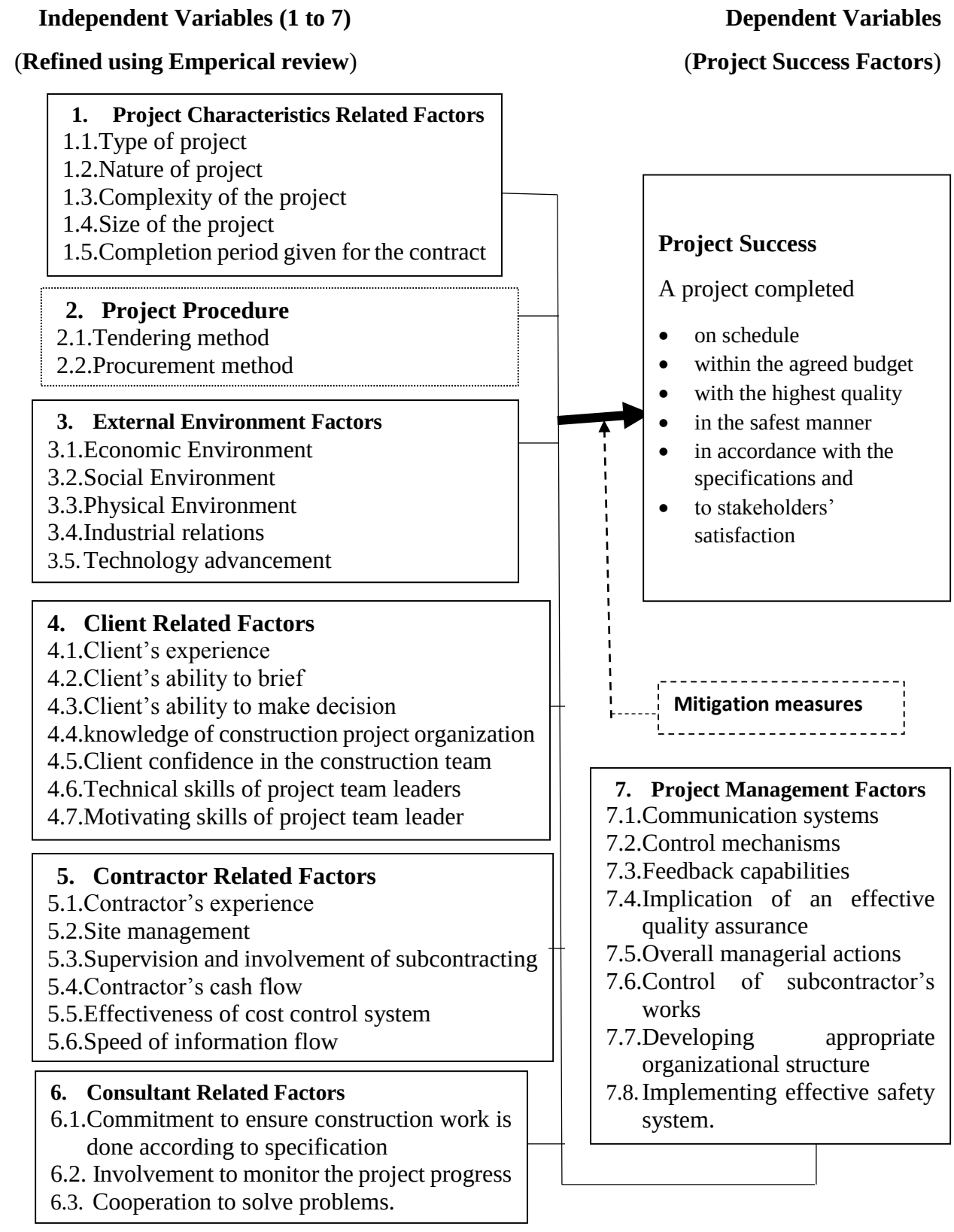


Fig. 3 Conceptual Framework Source: (Adapted from: Nyangwara &Datche, 2015)

CHAPTER THREE

RESEARCH METHODOLOGY

3.1. INTRODUCTION

This chapter mainly deals with the description of the methods and procedures that were followed while carrying out the study. It consists of research design, target population, sample size and sample selection, research instruments, data collection procedures and data analysis techniques.

3.2. RESEARCH DESIGN

A quantitative method of data collection through questionnaire survey was used to elicit the attitude of owners, consultants, and contractors towards the factors affecting the effectiveness of Aysha wind energy generation construction project. These factors were firstly refined from previous literatures and journals reviewed and then 36 factors believed to affect project performance were considered in this study and were listed under 7 groups. Based on these list of factors, the questionnaire is designed to collect professionals' views on the relative importance of these factors (the questionnaire is attached in Appendix 1). The questionnaires had both structured and unstructured questions. This study prefers the use of questionnaires because of the simplicity in their administration, scoring of items and analysis. It was expected from respondents to indicate, based on their local experience, the level of importance of each one of the identified 36 factors of performance on a five-point Likert scale as: not important, slightly, moderately, very, and extremely important. The unstructured part of the questionnaire contains explanatory type questions in order not to block the respondents' views from explaining their perceptions with their own words.

3.3. RESEARCH POPULATION AND SAMPLING

3.3.1. SAMPLING DESIGN

3.3.1.1. Target Population of the study – The target population consists of Contractors/ subcontractors, clients and consultants which have role in Aysha wind energy generation construction project. Out of these, short term subcontract workers, daily laborers and so on which couldn't be addressed at the time of the study were not

considered. So all the project participants that could be addressed at the time of the study through questionnaire in paper and through email were invited. Questionnaire in paper was distributed to those in home office in Addis Ababa and the questionnaire was sent through email to those in project site.

3.3.1.2.Sampling frame – the target population was categorized in to four frames. Managers, department heads, technical workers and non-technical workers.

3.3.1.3.Choosing sampling techniques - A total of 45 questionnaires were distributed 15 to owners, 15 to consultants and 15 to contractors as shown in the table below.

Target population	**Main Contractor/ subcontractor**	**Client**	**Consultant**
Managers	**1**	**1**	**1**
Department Heads	**3**	**3**	**3**
Technical workers (Experts, design Engineers)	**7**	**7**	**7**
Non-Technical workers (Administratives)	**4**	**4**	**4**
Determined Sample size	**15**	**15**	**15**
Total Determined Sample Size	**45**		

Table 2: Sample size determination

3.4. DATA COLLECTION PROCEDURES

The survey was conducted through printed questionnaire and email. The printed questionnaires were distributed to the clients, consultants and contractors available in their respective offices in Addis Ababa. Whereas email was sent to the respondents available at the project site. Out of the respondents available in Addis Ababa, 10 were from the owner, 11 from consultant and 6 were from contractor. The remaining respondents 5 from owner, 4 from consultant and 9 from contractor were communicated through email with the help of the owner's project manager. The questionnaires were distributed in Addis Ababa office in the morning shift. Then after the responses were collected in the afternoon. Whereas the respondents at project site were communicated through email in the afternoon shift. The replies were received the next day.

3.5. DATA ANALYSIS TECHNIQUE

After collection of the data it has to be processed and analyzed in accordance with the outline laid down for that purpose at the time of developing the research plan. Data collected was coded with regard to the type and source. Data was analyzed and interpreted both qualitatively and quantitatively in the light of the research objectives. The Relative Importance Index method (RII) was used herein to determine owners', consultants', and contractors' perceptions of the relative importance of the identified performance factors. The RII was computed as

RII = (ΣW_t)/(AXN)

Where $\mathbf{W_t}$ is the weight given to each factor by the respondents and ranges from 1 to 5;

A – the highest weight = 5; **N** – the total number of respondents.

To compute the Relative Importance Index (RII), it was adequate to use excel sheet.

The top 10 ranked in accordance with the Relative Importance Index method were considered as the critical factors affecting the effectiveness of Aysha wind energy generation construction project.

To determine whether there is a significant degree of agreement among the 3 groups of respondents (owners, contractors and consultants), Kendall's coefficient of concordance was used as a measure of agreement among raters. Kendall's coefficient of concordance indicates the degree of agreement on a zero to one scale, and is computed by the following equation

$$W = \frac{12U - 3m^2 n(n-1)^2}{m^2 n(n-1)},$$

Where:

$$U = \sum_{i=1}^{n} \left(\sum R\right)^2,$$

***W* – Kendall's coefficient of concordance**

n – number of factors; m – number of groups; i – the factors 1, 2,…, n

ΣR_i – summation of rates in each factor

- Null hypothesis: H0: There is insignificant degree of agreement among owners, contractors and consultants.
- Alternative hypothesis: H1: There is a statistically significant degree of agreement among owners, contractors and consultants.

If the value of Kendall's coefficient of concordance W is greater than or equal to 0.5, i.e. nearer to 1, then there is a statistically significant degree of agreement among owners, contractors and consultants. However if Kendall's coefficient of concordance W is less than 0.5, i.e. nearer to 0, then there is insignificant degree of agreement among owners, contractors and consultants.

Consequently, mitigation measures for the problems will be listed out based on the top ranked factors and based on the qualitative data collected through explanatory part of the questionnaire.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1. INTRODUCTION

This chapter presents the response rate of the questionnaires distributed, the results of the data collected, summary of the study findings, and outcome of the data collected and analyzed.

4.2. RESPONSE RATE AND DEMOGRAPHIC DATA

There was 100% return rate of questionnaires because the researcher has persuaded the managers that the result of the research will have great role in improving the performance of the project itself. Consequently, the managers have motivated their respective employees to respond the questionnaires as carefully as possible. Out of the respondents, 30% have studied post graduate programs in the technical and managerial discipline. The rest have degree in the technical or managerial discipline. The respondents have an average of 14 years of experience with 30% of the respondents having more than 20 years of experience in construction industry or related sector.

4.3. RESULTS AND FINDINGS

The following table summarizes the computed Relative Importance Indexes (RIIs) and their ranks as perceived by the 3 responding groups.

Table 3: Summary of Relative Importance ndex and rank for factors affecting the effectiveness of Aysha wind energy generation construction project.

No.	POSSIBLE FACTORS THAT COULD AFFECT THE EFFECTIVENESS OF ENERGY GENERATION CONSTRUCTION PROJECTS	OWNER		CONSULTANT		CONTRACTOR	
		RII	RANK	RII	RANK	RII	RANK
1	**project characteristics related factors**						
1.1	Type of project	0.427	34	0.400	34	0.387	34
1.2	Nature of project	0.747	19	0.773	15	0.760	19
1.3	complexity of the project	0.600	27	0.573	27	0.547	29
1.4	size of the project	0.627	26	0.573	27	0.573	28
1.5	completion period given for the contract	0.440	32	0.480	31	0.400	33
2	**Project procedure**						

2.1	Tendering method	0.867	1	0.880	1	0.893	1
2.2	Procurement method	0.853	3	0.840	2	0.867	3
3	**External Environmental Factors**						
3.1	Economic Environment	0.867	1	0.840	2	0.880	2
3.2	Social Environment	0.413	35	0.413	33	0.387	34
3.3	Physical Environment	0.440	32	0.387	35	0.413	32
3.4	Industrial Relations	0.707	22	0.747	18	0.693	22
3.5	Technology Advancement	0.360	36	0.333	36	0.333	36
4	**Client Related Factors**						
4.1	Client's experience	0.573	29	0.547	30	0.533	30
4.2	Client's ability to brief	0.493	31	0.440	32	0.467	31
4.3	Client's ability to make decision	0.840	5	0.827	5	0.840	5
4.4	Client's knowledge of construction project organization	0.733	20	0.720	21	0.680	23
4.5	client confidence in the construction team	0.560	30	0.560	29	0.627	25
4.6	Technical skills of project team leaders	0.600	27	0.613	26	0.613	27
4.7	Motivating skills of project team leaders	0.707	22	0.693	23	0.627	25
5	**Contractor related Factors**						
5.1	contractor's experience	0.813	7	0.813	8	0.840	5
5.2	site management	0.800	10	0.787	11	0.813	10
5.3	supervision and involvement of subcontracting	0.813	7	0.800	10	0.827	9
5.4	contractor's cash flow	0.853	3	0.840	2	0.840	5
5.5	effectiveness of cost control system	0.760	15	0.707	22	0.800	11
5.6	speed of information flow	0.760	15	0.747	18	0.787	15
6	**consultant related Factors**						
6.1	consultant's commitment to ensure construction work is done according to specification	0.787	11	0.813	8	0.760	19
6.2	consultant's involvement to monitor the project progress	0.760	15	0.787	11	0.800	11
6.3	consultant's cooperation to solve problems	0.693	25	0.733	20	0.680	23
7	**Project management factors**						
7.1	communication systems	0.720	21	0.667	25	0.773	17
7.2	control mechanisms	0.707	22	0.680	24	0.733	21
7.3	Feedback capabilities	0.787	11	0.773	15	0.800	11
7.4	Implication of an effective quality assurance	0.773	14	0.787	11	0.787	15
7.5	overall managerial actions	0.840	5	0.827	5	0.840	5
7.6	control Subcontractor's works	0.813	7	0.827	5	0.853	4
7.7	Developing appropriate organizational structure	0.787	11	0.787	11	0.773	17
7.8	Implementing effective safety system	0.760	15	0.773	15	0.800	11

Table 4: The top significant factors affecting the effectiveness of Aysha wind energy generation construction project

No.	FACTORS	OWNER		CONSULTANT		CONTRACTOR	
		RII	RANK	RII	RANK	RII	RANK
2.1	Tendering method	0.867	1	0.880	1	0.893	1
2.2	Procurement method	0.853	3	0.840	2	0.867	3
3.1	Economic Environment	0.867	1	0.840	2	0.880	2
4.3	Client's ability to make decision	0.840	5	0.827	5	0.840	5
5.1	contractor's experience	0.813	7	0.813	8	0.840	5
5.2	site management	0.800	10	0.787	11	0.813	10
5.3	supervision and involvement of subcontracting	0.813	7	0.800	10	0.827	9
5.4	contractor's cashflow	0.853	3	0.840	2	0.840	5
6.1	consultant's commitement to ensure construction work is done according to specification	0.787	11	0.813	8	0.760	19
7.5	overall managerial actions	0.840	5	0.827	5	0.840	5
7.6	control Subcontractor's works	0.813	7	0.827	5	0.853	4

As can be seen from the table, the three most important factors affecting the effectiveness of Aysha wind energy generation construction project according to the perception of owners, consultants, and contractors are: Tendering method, Economic environment and procurement method.

According to owners, consultants and contractors, it seems that the tendering method was the most important effectiveness factor as it has the first rank among all factors with relative importance index (RII)= 0.867 for owner, 0.880 for consultant and 0.893 for contractor. Economic environment seems the second most important factor for the consultant and contractor with relative index of 0.867 and 0.840 respectively. However it is the first most important factor for the owner with relative importance index equal with that of tendering method 0.867. Procurement method is the third most important factor for the owner and contractor with relative index 0.853 and 0.867 respectively. However this factor is the second most important factor for the consultant equally with the relative index of the economic environment (0.840).

In the explanatory type questions, as per the data collected from the client manager and the consultant Resident engineer, tendering method was the most important factor. As per the project procedure, 85% of the project cost was financed from the loan obtained from Exim bank of China. So choosing a winning bidder for the design and construction of the project was not possible without the approval of the financer. Consequently interference of the financer enforces the client to choose a contractor that fulfill the desire of the financer than the skill and experience needed to construct the project. Moreover, the payment to the contractor was not released as per the request due to the reluctance of the financer. Because of this there were times that the contractor couldn't continue to the next phases of the project work.

The client manager and some of the administrative persons also described in the questionnaire that economic environment has also affected the project. As per their description, the financer has been showing less desire in releasing payment to the contractor because the country's external loan has reached beyond the limit. From this it can be seen that economic environment of the country has affected the construction of the project.

The procurement method was the third most important factor as ranked by the client and contractor and the second important factor as ranked by the consultant. As per the responses described in the explanatory questions, there was a design and specification change requested by the contractor. This design change was requested by the contractor after all the initial designs were approved and some preparations were made to procure the main components of the project. This has led to stopping of procurement contracts with initial designs and re-reviewing for approval of the new design, and then making new procurement contracts. This all has led to a delay of the project for significant amount of time. As per the client's explanation, it couldn't refuse the change of the design due to the advancement in technology of the new design.

The contractor's cash flow is ranked 2nd by the consultant with Relative Importance Index of 0.84 and ranked 3rd by the client with Relative Importance Index of 0.853 and ranked 5th by the contractor with Relative Importance Index of 0.84. The other important factors affecting the effectiveness of Aysha wind energy generation construction project are:

Client's ability to make decision, overall managerial actions, control of subcontractor's works, contractor's experience, supervision and involvement of subcontracting, site management and consultant's commitment to ensure construction work is done according to specification.

Table 5: Summary of Relative Importance Index and rank of major groups affecting the effectiveness of Aysha wind energy generation construction project.

No.	MAJOR GROUP FACTORS AFFECTING THE EFFECTIVENESS OF AYSHA WIND ENERGY GENERATION CONSTRUCTION PROJECT	OWNER		CONSULTANT		CONTRACTOR	
		RII	RANK	RII	RANK	RII	RANK
1	**project characteristics related factors**	0.568	6	0.560	6	0.533	7
2	**Project procedure**	0.860	1	0.860	1	0.88	1
3	**External Environmental Factors**	0.557	7	0.544	7	0.541	6
4	**Client Related Factors**	0.644	5	0.629	5	0.627	5
5	**Contractor related Factors**	0.800	2	0.782	2	0.818	2
6	**consultant related Factors**	0.747	4	0.778	3	0.747	4
7	**Project management factors**	0.773	3	0.765	4	0.795	3

The Relative Importance Index (RII) of each of the Factor group is calculated by averaging the Relative Importance Index of each of the specific factors in the group. This is calculated separately for owners, consultants and contractors.

As indicated in the table, the project procedure group has been ranked by owners, consultants and contractors' respondents in the first position with RII equal to 0.86, 0.86 and 0.88 respectively. This group is the most critical factor for the owner, consultant and contractor because of the tendering methods and procurement methods that affected the effectiveness of the construction project.

The contractor related factors group is ranked by owners, consultants and contractors' respondents in the second position with RII equal to 0.8, 0.782 and 0.818 respectively. This could be because the contractor is responsible for all the design and construction works since the contract is EPC-turnkey contract.

The project management factors group is ranked in third position by the owner and contractor with RII of 0.773 and 0.795 respectively. However it is ranked in the 4^{th} position

by the consultant with RII equal to 0.765. In this group, the factors namely overall managerial action and control of subcontractor's works have contributed greater role in the significance of the group. Some respondents have explained in the questionnaire that the civil subcontractor employed by the main contractor doesn't have efficient skill and resource. So control of subcontractor's works is critical factor.

The consultant related factors group is ranked 3rd by the consultant itself with RII equal to 0.778. However it is ranked 4th by the owner and contractor with RII equal to 0.747 each. In this group "consultant's commitment to ensure construction work is done according to specification" is more significant in the group.

The client related factors group is ranked 5th by owners, consultants and contractors with RII equal to 0.644, 0.629 and 0.627 respectively. In this factors group, the specific factor "client's ability to make decision" affects significantly the effectiveness of the project.

The project characteristics related factors group is ranked 6th by both owners and consultants respondents with RII equal to 0.568 and 0.560 respectively. However it is ranked 7th by the contractor with RII of 0.533. From the specific factors in this group, "the nature of the project" is the most critical factor in the group. In the explanatory part of the questionnaire, it is described that assembly of the wind turbines is one of the major tasks during construction of the project. However, to accomplish this task needs less windy environment. 'Waiting for a less windy weather to assemble main components of the wind turbine' is the nature of the project and this is the critical factor in that group.

The external environmental factors group is given the last rank (7th) by the owners and consultants respondents with RII equal to 0.557 and 0.544 respectively. However the contractor has given this factors group the 6th rank with RII of 0.541. From the specific factors in the group, the economic environment is the critical factor in the group.

4.3.1 Degree of agreement among responding groups

To determine whether there is a significant degree of agreement among the 3 groups (owners, contractors, and consultants) Kendall's coefficient of concordance is used as a measure of agreement among raters.

- Null hypothesis: H0: There is insignificant degree of agreement among owners, contractors and consultants.
- Alternative hypothesis: H1: There is a statistically significant degree of agreement among owners, contractors and consultants.

  In all the significant factors identified, the value of Kendall's coefficient of concordance is greater than 0.5 which is nearer to 1. So there is significant degree of agreement among the owners, contractors and consultant respondents.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1. INTRODUCTION

In this chapter, summary of the main research findings are presented, conclusions are drawn and recommendations to the stakeholders in the energy generation construction project will be made on a number of aspects that require to be addressed so as to facilitate effectiveness in the project's delivery to the satisfaction of the client and other beneficiaries.

5.2. SUMMARY

The critical factors that affect the effectiveness of Aysha wind energy generation construction project are identified in the previous section using a questionnaire-based survey. As per the research, the top 10 significant factors are Tendering method, Economic Environment, Procurement method, Contractor's cash flow, Client's ability to make decision, Overall managerial actions, Control of subcontractor's works, Contractor's experience, Supervision and Involvement of subcontracting, and Site management.

The critical factors group are also ranked and identified. These factors group in sequence are Project procedure, contractor related factors, Project management factors, Consultant related factors, Client related factors, Project characteristics related factors and External environmental factors group.

The degree of agreement among the responding groups (clients, contractors and consultants) was also statistically determined for each critical factor identified. The result indicated as there was significant degree of agreement among raters.

5.3. CONCLUSION

The results indicated that tendering method was the most important factor, as it has the first rank among all factors from the perspectives of owners, consultants, and contractors. This agreement between all target groups was traced to the difficulty of financing the project from loan and reluctance of the financer to release payment as per the request of the contractor. The other equally important factor for the owner and second important factor

for the consultant and contractor was the economic environment. This was also related to the reluctance of the financer to release payment due to Ethiopia's external loan has reached beyond the limit. The 3rd most important factor for the owner and contractor was the procurement method. This was the second most important factor for the consultant equally with the economic environment. The contractor has requested a design change request after the initial design was approved and procurement contracts were ready. This has resulted in a significant amount of time overrun. The other most important factors agreed by the owners, consultants, and contractors as the main factors affecting the effectiveness of Aysha wind energy generation construction project were: contractor's cash flow, Client's ability to make decision, overall managerial actions, control of subcontractor's works, contractor's experience, supervision and involvement of subcontracting, and site management.

5.4. RECOMMENDATIONS

The researcher recommends that the owner must work collaboratively with contractors and facilitate regular payments in order to overcome delays, disputes and claims. However for future projects the researcher recommends that the owner should secure the finance properly before starting construction of the project. Otherwise it would be advisable to stop financing such projects from loans and should consider other options like IPP and PPP.

The researcher also suggest that the owner should facilitate adequate trainings for its experts so that they could actively have their input in the process of decision-making. It is due to lack of skills of the owner's experts that they couldn't actively have their input during the changes in the design and specification of main components of the project by the contractor. For similar projects in the future, it is recommended by the researcher that before procurement processes are started, the design and specification processes should be carefully analyzed and completed in order to avoid design changes from the beginning. This is because design changes could cause in financial losses especially if procurement of main components of the project are started with the initial design and specification. Moreover this will cause significant amount of time overrun.

The researcher also suggest that the main contractor should take the full responsibility of the whole construction project than transferring some risks to subcontractor.

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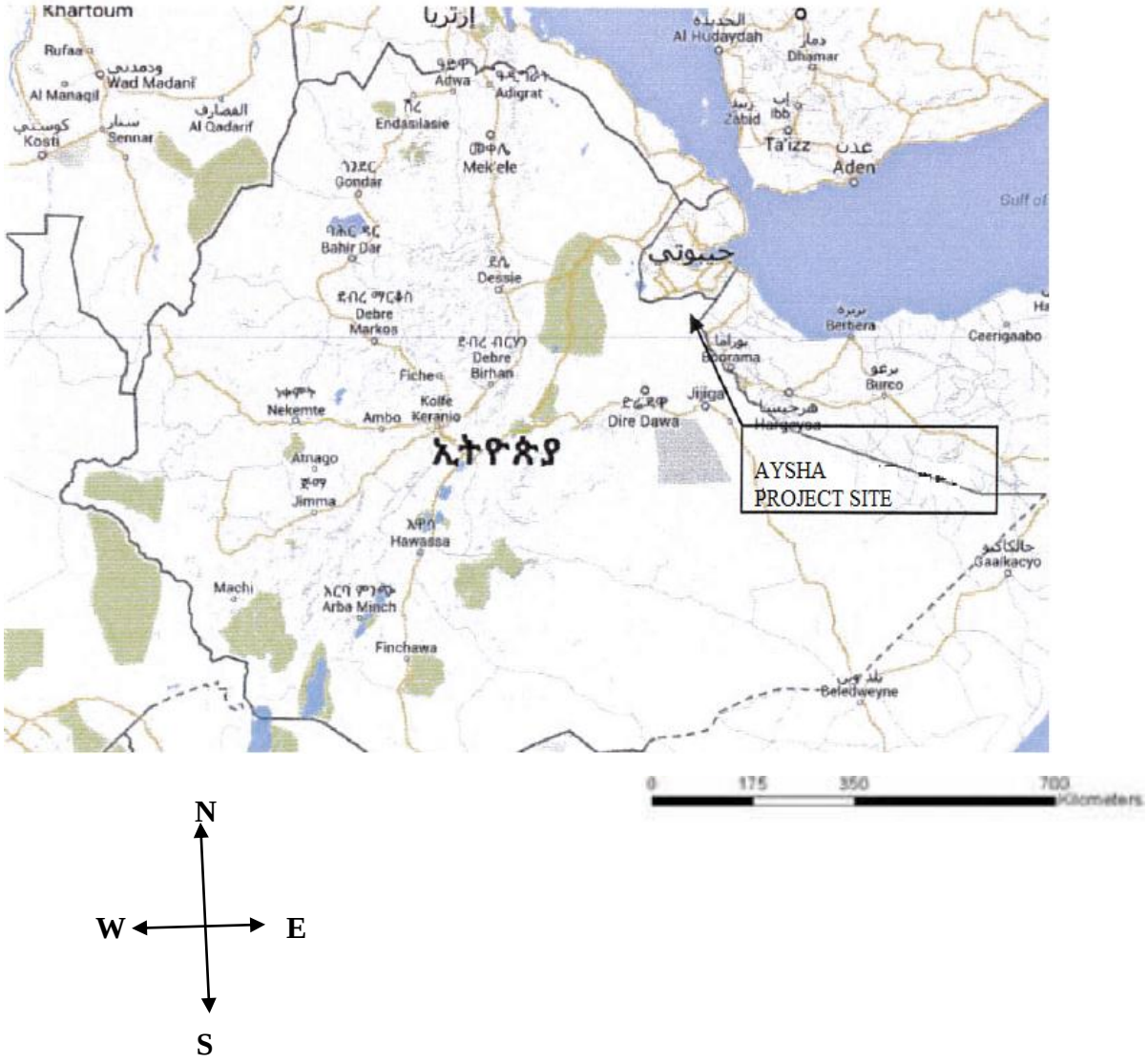
ANNEXES

ANNEX 1

Location Map of aysha wind energy generation construction project site



ANNEX 2

QUESTIONNAIRE FOR STAKEHOLDERS INVOLVED IN AYSHA WIND ENERGY GENERATION CONSTRUCTION PROJECT

This questionnaire is to be completed by stakeholders i.e. clients, consultants and contractors involved in Aysha wind Energy generation construction project. It seeks to investigate the factors influencing the effectiveness in implementation of Aysha wind energy generation construction project. Kindly answer all the questions as honestly and as fully as you can.

SECTION A

Background Information

Demographic: Choose the suitable answer and tick (√) the option that is most appropriate to you.

1. Gender: Male ☐ Female ☐

2. Age

20 – 29 ☐ **30 – 39** ☐ **40 – 49** ☐ **50 – 59** ☐ **60 years & Above** ☐

3. Highest education qualification

Certificate ☐ **Diploma** ☐ **Degree** ☐ **Masters** ☐ **Phd** ☐

Other (please specify) _____

4. Years of Experience in construction projects _____

SECTION B

5. Role in the Project

Owner ☐ **Consultant** ☐ **Contractor / Subcontractor** ☐

6. Put ☐ **/** under the scale provided to indicate the level of importance of each one of the identified 36 factors of performance on a five-point Likert scale as: 5= extremely important; 4=very important; 3= moderately important 2= slightly important and 1=not important

NO.	FACTORS AFFECTING EFFECTIVENESS OF ENERGY GENERATING PROJECTS	5	4	3	2	1
1	**Project characteristics related factors**					
1.1	Type of project					
1.2	Nature of the project					
1.3	Complexity of the project					
1.4	Size of the project					
1.5	Completion period given for the contract					
2	**Project procedure**					
2.1	Tendering method					
2.2	Procurement method					
3	**External Environment Factors**					
3.1	Economic environment					
3.2	Social Environment					
3.3	Physical environment					
3.4	Industrial relations					
3.5	Technology advancement					
4	**Client related factors**					
4.1	Client's experience					
4.2	Client ability to brief					
4.3	Client's ability to make decision					
4.4	Client's knowledge of construction project organization					
4.5	Client confidence in the construction team					
4.6	Technical skills of project team leaders					
4.7	Motivating skills of project team leader					
5	**Contractor related factors**					
5.1	Contractor's experience					
5.2	site management					
5.3	supervision and involvement of subcontracting					
5.4	contractor's cash flow					

5.5	effectiveness of cost control system					
5.6	speed of information flow					
6	**Consultant related factors**					
6.1	Consultants commitment to ensure construction work is done according to specification					
6.2	Consultants involvement to monitor the project progress					
6.3	Consultants cooperation to solve problems					
7	**Project management factors**					
7.1	Communication systems					
7.2	Control mechanisms					
7.3	Feedback capabilities					
7.4	Implication an effective quality assurance					
7.5	Overall managerial actions					
7.6	Control sub-contractors works					
7.7	Developing appropriate organizational structure					
7.8	Implementing effective safety system					

SECTION C: EXPLANATORY QUESTIONS

7. What factors do you think critically affected the construction of Aysha wind energy generation construction project? Explain in your own words.

_____

_____

_____

_____

_____

8, what mitigation measures do you recommend for the problem you described above?

_____

_____

_____

_____

_____