TECHNOLOGICAL MEDIATION IN SOCIOCULTURAL CONTEXT

A CASE STUDY OF THE SANGUL MECHANIZED WATER SYSTEM

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SUMMARY

The introduction of the concept of mediation in postphenomenological research has brought about a reconceptualization of human-technology relationships showing marked differences from the instrumentalist and determinist conceptualizations of technology. However, technological mediation research largely remains focused on the individual experiences leaving a gap in knowledge about the intersubjective experiences of technology in sociocultural contexts. From the perspective of the Sangul community in Ghana whose inhabitants are beneficiaries of a Mechanized Water System in a social development programme, I analyze the relations between the technology and the people and its impact on how they organize their daily lives and how they experience their world. I propose “technoformation” as a new construct which explains how the relations between people and technology co-shapes their perceptions and practices in a sociocultural context.

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DEDICATION

….to the future….

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LIST OF ABBREVIATIONS

- WVG _____World Vision, Ghana
- SDA_____Saboba District Assembly
- WASH_____Water, Sanitation and Hygiene
- PMV_____Pump Maintenance Volunteer
- CLTS_____Community-Led Total Sanitation
- CVA_____Citizen Voice of Action
- DWD_____District Works Department
- GoG_____Government of Ghana
- CBO_____Community-Based Organization
- PoT_____Philosophy of Technology
- STS_____Science, Technology and Society
- PSTS_____Philosophy of Science, Technology and Society
- TMT_____Technological Mediation Theory
- MWS_____Mechanized Water System

CHAPTER ONE

INTRODUCTION AND BACKGROUND

1.0 INTRODUCTION

Technological instrumentalism is the classical conception which argues that technology is nothing more than a means to an end (Feenberg, 1991; Heidegger, 1977; Kiran & Verbeek, 2010; Verbeek, 2005) however, some contemporary perspectives have argued to the contrary (Ihde, 1990, 2010). Specifically, technological mediation theory has been introduced in contemporary philosophy of technology literature as a new thought which regards technology as non-neutral yet co-shaping in its role in society and other forms of human experience (Bantwal Rao, Jongerden, Lemmens, & Ruivenkamp, 2015; Ihde, 1990, 2011; Tripathi, 2014; Van Den Eede, 2011; Verbeek, 2008c, 2012).

The formulation of perspectives of technology have not only been the concern of philosophers and other theorists, but also practitioners such as development professionals, politicians and policy makers whose decisions, processes and procedures tend to be influenced by some of these perspectives. For example, the movement for science and technology for development in the post-WWII era was informed by the instrumental view that technology “drives” development. Even more recent international development policies and interventions are still hinged on the idea that technological innovations are necessary conditions for attaining development (Smith, 2009). This study contends that a more critical view of the instrumental view

of technology is required especially in how it shapes development theory and practice. In order to develop an alternative perspective to the instrumental view, the study introduces the technological mediation perspective to explain the role of technology in a social context. Additionally, technological mediation itself is part of a developing school of thought – postphenomenology – and still requires more refinement through empirical research and in-depth case analyses of technology, especially about how it mediates social and cultural settings (Feenberg, 2009; Verbeek, 2009b; Waelbers, 2007). In line with this, the study examines the role of technology in sociocultural contexts in a way that contributes to further understanding of technological mediation as well as the role of technology for development.

1.1 BACKGROUND

The interest in exploring this subject area for research was primarily provoked by my own observations of the impacts of a technology-based intervention programme implemented by a Non-Governmental Organization (NGO) known as World Vision, in the Saboba District, Ghana. I observed that the implementation of water pumps in communities that lacked access to safe water and the subsequent function of these technologies in improving the lives of the people varied among communities. In some cases, the technology struggled to stabilize (Akrich, 1992) or even failed to drive development as intended (Saboba District Assembly, 2006; WVG Saboba ADP, 2013).

Furthermore, some new institutions and structures were created in communities to oversee the functioning of the water system and certain changes relating to the way of life (or culture) and behaviour of people in these communities could be noticed. Seeing the intertwining nature of impact of these water systems prompted me to question whether technology is merely a means to a goal or it actually 'did' more. Such questions about the extent to which technology influences human ways of life, perceptions and actions have existed in the various disciplines which provide background for me to examine this question more critically.

Consequently, I selected the Mechanized Water System in Sangul because it presents an empirical problem of finding out the actual impact of technology on the lives of the people of Sangul and, concomitantly, presents the empirical context within which the concept of technological mediation in a sociocultural setting can be discussed. On the one hand, a critical perspective is needed on the assumptions underlying the use of technology for development which may respond to the view that a lack of critical perspective of technology for development contributes to unsustainable development and failures in the implementation of technologies (Perkins, 2010). On the other hand, to analyze technological mediations in sociocultural contexts is to explore the role of technology in the daily lives of an organized group of people sharing a similar cultural and belief system.

1.1.1 TECHNOLOGY IN EVERYDAY LIFE

A common feature of most human endeavor is the assumption that artifacts, tools, machines, or systems are in some way essential parts of daily life which we can hardly

ignore. In societies with a high saturation of technology, technology becomes embedded in how social life is organized becoming almost *transparent* and taken-for-granted, whilst in less technologically saturated societies, the few technical artifacts and systems available are likely to be *opaque* and widely noticed (Kiran & Verbeek, 2010). Moreover, there is a growing trend across the globe with most people "catching up" with and adopting all types of modern technology – such as the mobile phones – at a fast pace making technology one of the ubiquitous elements of societies in this modern(Manca, 2010). But how do we define technology if there is so much of it around us coming in different forms and shapes?

The definition of technology is far from being unidimensional and one can differentiate among conceptualizations of technology which are oriented towards technology as a process, or a product of science and technology (Ihde, 1990, 1998). Within our common parlance, what comes into mind when we talk of technology are the tools and equipment we use. Don Ihde refers to the physical or artifactual elements of technology as "technics" or the "technical" (Ihde, 1990, p. 73). Also, the debate over the definition of technology as a product of science is far from settled and we can liken it to the "Chicken or Egg" puzzle, however, the term "technoscience" has been introduced and developed by philosophers of science and technology to reflect the close-knit relation between science and technology. In the absence of a universally-accepted definition of technology, one way of conceptualizing technology which I deem worthy of consideration is that presented by Don Ihde in the quotation below:

> "Technologies, insofar as they are artifactual (in a range from simple entities to whole complexes of systems), are developed, used, and related to by humans in distinctive ways. Yet while there is both a certain need to classify technologies as objects (which is often the first focus of objectivistic accounts), what will be focused upon here will be their set of human-technology relations, the relations which can best be exemplified in the kind of relativistic account suggested." (Ihde, 1990, p. 26)

This is a conceptualization of technology which takes cognizance of the artifactual nature of technologies, yet recognizes the ties of technologies to other conditions such as the relations with humans. On first sight, this conceptualization might be suggestive of a relativistic account of technology which ties technology to other conditions, however, its acknowledgement of the possibility of a relationship between technology and humans also suggests that there is that which can be identified as solely technological. Therefore, one can argue that technology finds itself in the midst of a gestalt system characterised by other entities including humans. The picture of this gestalt is illustrated further when technology is seen from a context which in many cases amounts to cultural or institutional frameworks within which technology exists.

The relevance of context to technology is undisputed irrespective of how much merit we seek to devote to the objectivity of technology itself. This is because context has been the laboratory from where technology is studied and explained. Most of the views of technology (whether utopian, dystopian, or in-between) which have been developed have come out of researcher's study of certain contexts or settings of technology. It has even being argued that "ways of seeing" (Verbeek, 2005, p. 137), especially among classical theorists, of technology has long being influenced by conditions rather by technology itself. According to Peter-Paul Verbeek, "the pronouncements that the

classical philosophy of technology made about technology pertained to the *conditions* of technology rather than to technology *itself*" (Verbeek, 2005, p. 234)

The position stated by Verbeek regarding technology and context does not only point to the inevitability of context when studying technology but also that we must put the impact of context in critical check when analysing technology. That is why in selecting the case for this study (i.e. The Mechanized Water System in Sangul, Ghana), three context-related elements are identified as interlocking: technology, society, and development.

1.1.2 TECHNOLOGY, SOCIETY AND DEVELOPMENT

The ubiquity of technology goes beyond geographical space extending to how it is used by people and the manner in which it is applied. One area in which technology is increasingly being used is for development (Berlinguet, 1981; Oosterlaken, 2009; Smith, 2009; United Nations, 1979). Development has emerged as a robust field of study and practice in our time and scholars agree that "development is notoriously difficult to define" (Smith, 2009, p. 4) therefore, my aim here is not to offer a comprehensive definition of development or an expansive discussion of its theoretical and practical aspects, but rather offer a general understanding of development which reflects the perspective I adopt in this research.

One way to define development is to refer to it as "the absence of underdevelopment", however, it has long being argued that "*Underdevelopment* is not just the *lack* of *development"* (Krishnan-Kutty, 1999). The UN defines development in terms of

"means" and "ends" where "economic growth" is seen as a means to "human development" as the end (United Nations, 1996, p.1). Most development theories are candidly theories of economic development built on the premise that development can be achieved through social and economic wellbeing. As a result, development theorists mainly concern themselves with ways in which to improve the economies of less-developed societies or ways by which social problems can be overcome through sound socio-economic measures. Some of these "economic theories" of development, although focused on the analysis of economic factors, have often made reference to technological components.

In many cases, these three elements (technology, society and development) have come as topics for research leading to a number of theories about the impact of technology on how societies develop. One such theory is Rostow's theory of economic growth written in 1960 (Rostow, 1960). At best, Rostow's theory belong to the group of theories commonly referred to as *stage theories* which present development as progression from stages of lower economic development to stages of higher economic development over time and characterized by some identifiable conditions. In Rostow's theory, an important condition in modernization of nations is advancement in technology, which forms the basis for the suggestion that the adoption of technology is a necessary condition for economic development. But Rostow's theory is only but one example of the many theorists who view technology as a "driver" of development - instrumentalism.

James Smith suggests in his book titled *"Science and Technology for Development"* that development practitioners as well as some theorists hold on to the view of technology as a driver of development (Smith, 2009, p. 12). By holding to this view in both theory and practice of development, technology is assigned its essence as a means to achieving ends. Whilst this position on technology can be underpinned by evidence on the "magic" that technology works when introduced in development contexts, it hardly goes unchallenged, especially by philosophers and other scholars in the study of technology who have for long put the question of essence of technology under scrutiny. There are the pure technological determinists who are convinced that everything social is the result of some technological design or function. An example is Langdon Winner (Winner, 1986) whose analysis of bridges connected it to social stratification and race relations. The technological determinists hold steadfastly to an essentialist view of technology. But there is also the instrumentalist view of technology (Feenberg, 1991; Tiles, 1995), who argue that technology is inherently non-essential and therefore neutral and are only moulded into "good or evil" by human beings. According to the instrumentalists, it is only by application that technology assumes essence. This is the position stated in Mary Tile and Hans Oberdiek who made two broad categorizations between optimistic and pessimistic technology theorists.

> "Optimists hold that technology and its products are value neutral; technologies are passive tools which can be used for good or evil. If technology is sometimes used Living in a technological culture improperly and causes harm, the fault lies with its human operators and developers, not with the technology. As the proverb goes, 'It is a poor carpenter who blames his tools." - (Tiles, 1995, pp. 10-11)

Once again, the reference to the conditions of technology as well as its context is eminent in arguments made by the determinists and instrumentalists. The instrumentalist argument suggests that technology can either be good or evil for development depending on how people use it, whilst the determinists suggest that technology determines the trajectory of development (positively or negatively). In effect, both views, although seemingly different, do share much commonality when considered in the context of social development. Furthermore, their merit in explaining the actual role of technology in society has been questioned in more contemporary studies. Below, I discuss the concept of mediation which has risen, alongside the development of the postphenomenology in philosophy of technology, to challenge some of the assumptions of determinism and instrumentalism.

1.1.3 POSTPHENOMENOLOGY AND TECHNOLOGICAL MEDIATION

The idea of technology as "driver" or "means to an end" is neither limited to development theory and practice nor new to philosophy of technology. It is associated with earlier phenomenological studies of technology such as those by Martin Heidegger, Edmund Husserl, and Maurice Merleau-Ponty. Earlier, these and other philosophers were confronted by questions concerning technology, and Martin Heidegger is prominent for posing a question about the essence of technology in his text *"The Question Concerning Technology"* (Heidegger, 1977)[1]. Even then,

[1] Originally authored in 1954 by Heidegger in German "*Die Frage nach der Technik"* and translated later in 1977 into English "The Question Concerning Technology and Other Essays" (Heidegger, 1977).

Heidegger's inquiry into the essence of technology examined what technology is in fundamental anthropological sense which came out to be as one of the earliest phenomenological theses on technology. He expressed that "technology is not equivalent to the essence of technology" and that the "essence of technology is not by any means technological" (Heidegger, 1977, p1).

Heidegger presented some claims which identify with the view of technology as a means to an end. One of these claims was that technology is not neutral, instead "modern technology too is a means to an end" (Heidegger, 1977, p3). Heidegger, argued that technology has a "purpose" and follows a course which he explained using the Aristotelian causes. His claim of the non-neutrality of technology and defense its purposiveness or causal character implies that technology is instrumental which he defended by saying the "the instrumental definition of technology is so uncannily correct that it even holds true for modern technology" (Heidegger, 1977, p2). Heidegger's period was also characterized by dystopian ideals of technology which advanced the popularity of technological determinism among the philosophers of that time.

In contemporary philosophy of technology, Heidegger still remains an important figure, mostly as a point of reference in discussion technology-human relations. Following the foundational theorems laid by the earlier philosophers (and also revising them), postphenomenology has emerged as a new school of thought in philosophy of technology aiming to better account for the experience of technology (Ihde, 2008b, 2009; Verbeek, 2008c). It is in postphenomenology that technological mediation has

emerged as a concept for analyzing the relations between technology and human beings from a more intricate perspective (Bantwal Rao et al., 2015; Ihde, 2011; Kiran, 2012; Van Den Eede, 2011; Verbeek, 2008c, 2012, 2015). The introduction of the concept of mediation in postphenomenological research has brought about a reconceptualization of human-technology relationships showing marked differences from the instrumentalist and determinist conceptualizations of technology. However, technological mediation research largely remains focused on the individual experiences leaving a gap in knowledge about the intersubjective experiences of technology in sociocultural contexts.

1.2 THE PROBLEM

As I indicated above, the technology in focus in this study is the Mechanized Water System in Sangul and it is from the case of this same technology that I present the problem for this research. The Mechanized Water System is a technical infrastructure installed as part of a social development program in a local community called Sangul in Ghana (WVG Saboba ADP, 2013). This qualifies it as a *technology for development* (Smith, 2009). The validity of the view of technology as a driver is increasingly being questioned because it is getting more and evident that the role of technology goes beyond driving development. For example, whilst the main goal for providing this water system to the community is to get them access to potable water, its impacts on their lives transcends their water needs. Also, the very presence of the technology as a visible infrastructure in the community as well as the relations within the community that develop in response to the need to maintain the technology indicates more impact

going beyond the immediate goals for which it was installed. For instance, changes in perceptions and practices relating to roles, status, leadership and governance relations, and education as well as changes in household structure some of which I noticed during my days as a volunteer working with the teams that provided similar systems in other communities in Saboba

Additionally, there is increasing understanding among scholars that "technological interventions in society rarely play out as they had been planned" (Smith, 2009, p. 65), however, not much is known about these changes in sociocultural settings from the technological mediation perspective in philosophy of technology. This is due to limited empirical research on technological mediation in sociocultural contexts. As a result, I find it interesting to examine the experience of the technology and how the dominant perceptions and practices in the community transform following the introduction of technology as well as examine technology's role in the society from a technological mediation approach instead of an instrumentalist approach.

1.3 GENERAL RESEARCH QUESTION

What role does the Mechanized Water System play in how people make sense of the world in Sangul?

1.3.1 SPECIFIC RESEARCH QUESTIONS

Question 1: In which ways do people in Sangul relate with the Mechanized Water System?

Question 2: What role do the relationships between the Mechanized Water System and people in Sangul play in how their perceptions and practices take shape?

Question 3: How can the relationship between the Mechanized Water System be explained from technological mediation approach, and which implications does the analysis of the relations between the mechanized Water System and people in Sangul have on our understanding of the technological mediation approach

Question 4: How can research on technological mediation in sociocultural context contribute to a better understanding of *technology for development* and expand understanding of the concept of mediation in postphenomenology?

1.4 GENERAL RESEARCH OBJECTIVE

From the technological mediation approach, analyze the role of the Mechanized Water System in how people make sense of the world in Sangul.

1.4.1 SPECIFIC RESEARCH OBJECTIVES

Objective 1: Analyse the relations between the Mechanized Water System and people in Sangul.

Objective 2: Analyze the role of the Mechanized Water System in co-shaping perceptions and practices in Sangul.

Objective 3: Get a better understanding of the mediations of the Mechanized Water system and how people in Sangul experience them. Identify the implications on our understanding of the technological mediation in sociocultural context.

Objective 4: Formulate an evidence-based and theory-informed framework which contributes to understanding, design and implementation of *technology for development*.

1.5 RESEARCH JUSTIFICATION AND SIGNIFICANCE

On the one hand, one may question what development theory and practice has to do with philosophy of technology, or in other words, what does theory and practice of development have in common with philosophical thought of technology? We could make assumptions about the similarities and differences between theory and practice of development and philosophy of technology, or even conduct a comparative study of both disciplines to understand what they share or how they depart from each other. However, there are three irrefutable factors which we can identify: First is that technology is used in social development – *technology for development* (Smith, 2009)*;* second is the seemingly not-so-close relation between what development workers do with technology and what philosophers think about technology; third is: the fact that philosophy of technology concerns itself with technology as main theme makes *technology for development* a (potential) subject in philosophy of technology. According to Smith (2009):

> "development, in using science and technology, seeks to improve our lives and fulfill our wants and needs, or at least stimulate those wants and needs, and for that reason it is important that we take due care in understanding how technology for development has impacted upon our world and how it will continue to do so in the future" – (Smith, 2009, p. 10)

The three factors mentioned raise some questions about technology and development: how do the common views of technology among development theorists

and practitioners coincide with the common views of technology in philosophy of technology? How can *technology for development* and philosophy of technology benefit from each other? And what prospects are there for a philosophy of technology which focuses on the analysis of perspectives of *technology for development* and its impacts on human beings? These questions lace the frontiers of this research which come primarily as theoretical problems and their relevance in in current research goes undisputed.

Further, the concept of mediation in postphenomenology needs more work especially regarding the experience of technology in sociocultural settings. Philosophers agree that the mediation approach requires improvement especially regarding empirical research. Peter-Paul Verbeek stated in his reply to reviewers of his book that:

> "the mediation approach shows how any technological artifact-in-use has a social and cultural impact and therefore always makes a political intervention that can be addressed in political terms. In order to make things better, we don't get there by producing yet another analysis of the importance of companies and economic classes. We will have to inspire practices of use and design, and of policy-making. To make a change, we cannot suffice with analyzing social structures and the roles of class and capital—we need to address the materiality of technology as well. (Verbeek, 2009b, p. 256)

The lack of adequate understanding and explanation of society level human-technology relations translates into a lack of adequate understanding of the perceptions and practices in social contexts and how they associate with technology. Don Ihde (1990) does discuss "technology transfer", but in a way that does not reveal much about how the technology co-shapes specific thoughts and actions. Similarly, de Laet and Mol (2000) discussed the "mechanics" of the Zimbabwe water pump

system in a way that focuses more on issues of design than on issues of human-technology relationships. Here, I attempt to extend analysis beyond the "mechanics" of technology to the actual "mechanisms" of the Mechanized Water System in Sanguli. This way, I hope contribute to philosophy of technology by increasing the understanding of technological mediations. As Fuller puts it:

> "What scientists no longer have and STS researchers refuse to supply traditionally has been provided by philosophy." (Fuller, 2006, p. 4)

My study responds to the need to understand technology for development better by examining a possible alliance between the practice and theory of technology for development and postphenomenology. Thus, I will focus on the mediations of the Mechanized Water System in order to demonstrate that it is not merely a tool to provide potable water for the community but does mediate certain aspects of the society and human life such as perceptions and practices, rather than "drive" them.

1.6 OUTLINE

Chapter One: This study comes in five chapters and the first chapter contains introduction to the core issues in the study, the problem at stake, research questions and objectives as well as the significance and justification of the research.

Chapter Two: The second chapter contains literature review on theories and concepts which are relevant to this research. Also, the chapter carries the theoretical framework I have formulated in this study.

Chapter Three: The third chapter offers information about the methods and techniques I adopted during the research process and the characteristics of my research area and

participants. Here, I also offer justifications for which the chosen methods are deemed appropriate.

Chapter Four: The fourth chapter is where I present and discuss findings from my interview with participates. It is also in this chapter that I relate the findings from the empirical aspect with the theoretical framework.

Chapter Five: The final chapter concludes with further analysis and an extended discussion on technology in society and the effects on how perceptions and practices are shaped. This chapter is dedicated to expatiating on the concept of technoformation which I propose to explain sociocultural mediation. The final parts of the study contains summary and conclusion, suggestion for further research, a reference list of cited literature and appendices of diagrams and images that illustrate the Mechanized Water System.

CHAPTER TWO

LITERATURE REVIEW: TECHNOLOGY AND THE HUMAN BEING

2.0 INTRODUCTION

In the introductory chapter, I already outlined that the view of technology in this discussion constitutes the artifacts and techniques used for development purposes – in other words *technology for development,* hence, the scope of my inquiry is limited to technologies used in development theory and practice. The reference to technical artifacts is not to elevate a view of 'Technology, with the capital "T" (Verbeek, 2009b,

p. 253), instead it is to find out how technological artifacts mediate social reality. A good understanding of technology is not one which is limited to just one context, instead it is one which speaks to technology as both an entity and subject in existence. This is why my attempt to expound on technology re-visits the earlier inquiries into technology as well as the latest trends in technology studies. More specifically, I navigate through philosophy of technology and anchor my discussions in key the concept of technological mediation. My approach in this literature analysis is to take neither a techno-centric approach nor a human-centric one, instead, I intend to share honours between technology and the human being in order to illustrate, as clearly as possible, how they relate with each other. I explore the earliest instrumental views of technology and arrive at the more recent wave within philosophy of technology and science and technology studies oriented towards a mediating view of technology.

2.1 THEORIZING TECHNOLOGY

Ongoing discourse on technology is considerably broad and diverse in disciplinary terms. Technology is practically a subject of discussion in all scholarly circles and one can make the broad categorical distinction of: those who study technology by looking back at history and the development of society; those concerned about technology and its role in current times; and those who pry into the future from the perspective of technology.

The first group mostly comprise of historians of technology, whilst the second and third are more likely to include phenomenologists and transhumanists respectively.

Nonetheless, the study of technology has always been more complex than these three generalized categories. For example, earlier classical thinkers (philosophers and sociologists) such as Karl Marx (1818-1883), August Comte (1798-1857), attempted to explain the conditions of their time by tracing social currents to historical events. An example is Auguste Comte's Law of Three Stages (Comte, 1876) which has become one of the earliest references of positivism in the philosophy of science. Karl Marx also developed his historical materialism and ideas of the industrial-capitalist society by looking into events which have historical roots but were also relevant in his time (Coser, 1971).

From these earlier times, some of these thinkers already laid foundations for the development of perspectives of technology such as technological determinism. Whole disciplinary fields in the social sciences and humanities have emerged and still evolving over the last half century, all making attempts to account for the phenomenon of technology in society. Mainly, there are Science, Technology and Society Studies (also known as Science and Technology Studies) which is popularly dubbed STS (Sismondo, 2011) and; the Philosophy of Technology (P. Brey, 2009; Fuller, 2006; Ihde, 2005) also known as PoT in short. A relatively recent development is the postphenomenological approach and, precisely, its theory of technological mediation (Verbeek, 2005, 2008a, 2008c, 2009c, 2012, 2015; Verbeek & Slob, 2006) serves as primary conceptual lens in this research. The technological mediation theory is unique in its predisposition to more anthropological analysis of technology.

2.2 STS AND PoT APPROACHES

In the earlier technology studies, technology was given an active role as a determining force in how things play out. For example, Edmund Husserl and martin Heidegger linked technology with alienation (Moran & Cohen, 2012, p. 192), in which a causal relationship is given between technology and the human condition. However, what draws critique from these causal explanations is not only the disputability of the existence of causal linkages but also doubts about the suggested strength of such linkages. That is why the determinist model has been revised by some scholars (Wiebe Eco Bijker & Hughes, 1987; Wiebe E. Bijker & Law, 1992) and an alternative and almost opposite view of determinism – social construction – was developed.

2.2.1 SCOT and ANT

In the STS domain of technology studies, innovation studies, sociology of technology, feminist studies of technology, semiotic approaches and media and cultural approaches dominate and have mainly focused on user-technology relations as a part of a “general phenomenology of technology” by Don Ihde (Oudshoorn & Pinch, 2008, p. 541). The outcome of such studies are theories such as the Social Construction of Technology (SCOT) (Wiebe Eco Bijker & Hughes, 1987), Actor-Network Theory (Latour, 2005a), Domestication (Silverstone & Hirsch, 1994), technology assessment.

The Actor-Network Theory (ANT) (Latour, 2005b) is famed for its strict symmetrical view of relations between humans, on the one hand, and non-humans, on the other hand. In effect, ANT does make a non-nuanced distinction between the technological and the social. Viewed from one perspective, it can be said that this strong distinction

seeks to highlight how much qualitative differences there are between the human and non-human categories, however, the claim for a sharp symmetry between human and non-human has often been the main Achilles heel referenced by opponents of this theory.

ANT can be criticized as intentionally oblivious to the intricate relations that occur between human and non-human entities. However, I think it is important to keep a distinction between human qualities and non-human qualities even in analyzing intricate relations of technology and society because even though human and nonhuman elements can bond, through embodiment for example, it is still possible to differentiate the two and how they relate. If not so, then “technology and the human” can hardly exist as a subject for study because they will constitute one homogenous entity.

In philosophy of technology, it is common to address the problem of technology from different dimensions such as ontology, epistemology, hermeneutic, or existential, thus there is neither a definitive definition of what technology entails nor a general consensus on its role: To classical philosophers such as Heidegger (1954) who is considered the father of contemporary philosophy of technology (Ihde, 1990, p. 21) and Jaspers (Jaspers, 1951), technology connotes alienation and a threat to the very existence and essence of the human being; to Donna Haraway (1991), technology means a hybrid between the human being and machines; to Latour (1992), technology means a network of human and non-human actors; to Winner (1977, 1986), technology means politics (of discrimination and segregation); to Don Ihde (Ihde,

1979b, 1990, 1994, 1997, 1998, 2005, 2008a, 2010), technology means a lot more than just things as a result of it different forms of mediation in the lifeworld; to Peter-Paul Verbeek (P. Brey, 2006; Verbeek, 2005, 2008a, 2008b, 2009c), technology also means a lot from its mediating role and implications for morality, ethics, design and other anthropological dimensions. These references are just but a handful of numerous studies that have shown, in different ways, how technology turns out in different situations.

2.2.2 POSTPHENOMENOLOGY

A relatively recent development in PoT is the postphenomenological approach which has roots in Don Ihde's phenomenology (Ihde, 2009, p. 5). Prominent among those philosophers contributing to this view of technology are Don Ihde and Peter-Paul Verbeek. The postphenomenological movement has distinguished philosophers who have contributed to its conceptual and methodological development. Don Ihde is regarded as the "father" of this movement and he in turn recognized Peter-Paul Verbeek and Evan Selinger as the "'senior' postphenomenological analyst" (Ihde, 2008b, p. 7).

Don Ihde is an American and a Professor of philosophy of technology with a longstanding reputation in the philosophy of technology and has made tremendous contributions to the development of both phenomenological theory and the postphenomenological tradition in the philosophy of technology. Ihde's philosophy of technology is very much rooted in the works of three major classical philosophers of

technology, namely Heidegger, Husserl, and Merleau-Ponty by virtue of which postphenomenology itself is largely premised on phenomenology:

> "Ihde was one of the first to have brought phenomenology explicitly in contact with the philosophy of technology, by applying central phenomenological concepts and methods developed by Husserl, Heidegger, and Merleau-Ponty" (Verbeek, 2005, p. 121).

Ihde's ideas do not only rest with technology but also with science and mostly results in the analysis of technoscience (Ihde, 1998).

Peter-Paul Verbeek is a Professor of Philosophy of Technology with a longstanding reputation for avant-garde analysis and interpretation of technology, especially those that have transformed traditional notions and worldviews about the human being and their world. In this sense, he takes a more anthropological approach to the philosophy of technology. Much of what I draw from Verbeek's idea of technological mediation comes from his book entitled "What things do: philosophical reflections on technology, agency, and design" (2005) because it is in this book that Verbeek laid a good foundation on how to connect the tenets of theoretical philosophy of technology to empirical aspects such as design and culture. However, references from more recent publications are also included.

Further, in a similar fashion as Ihde, Verbeek starts his philosophy of technology by making references to the works of Heidegger, Husserl and Merleau-Ponty, which reinforces the indispensability of these earlier philosophers in discussing technology. He (Verbeek) underscored the unparalleled contribution of these classical philosophers to the early construction of thought on technology, which, although contestable, serve as key starting points in the analysis of technology. Verbeek's

critique of these earlier theorists takes a similar fashion as that by Ihde and argues that relations between people and the world should not be attributed to technological determinism but instead seen in the light of technological mediation which is the foundation of his philosophy.

> "Verbeek's overall goal is to establish a "postphenomenological" framework for understanding how technologies mediate between humans and the world. Critical to that framework is the complementarity of these two types of concerns interpretation and existence and the linkage of technological artifacts to these kinds of mediation. (Galusky, 2008, p. 146)

The contributions of these philosophers has shaped postphenomenology and perspectives of technology which has shown that although technology may be a universal phenomenon that exists in all societies, the same cannot be said of understanding and explaining technology and what it does in society. In effect, there is no one-size-fits-all universal explanation of technology because there is an inter-variability or multistability of technology (Rosenberger et al., 2015, p. 168). On the nature and process of this multistability, Ihde took a mediation approach as opposed to the seemingly deterministic approach by Heidegger.

Both Ihde and Verbeek elaborated on the multistable quality of technology with the example of the Necker Cube (Ihde, 1990, p. 146; Verbeek, 2005, p. 118) which expresses ambiguity as well as multiple dimensions when viewed from different perspectives. In this sense, the multistability of technology assumes that technology is not entirely rigid, but instead it is flexible and unpredictable in many cases, which makes it impossible to have certainty in a universal view of technology and its role. The example of the typewriter which was primarily designed for the visually-impaired

but accrued significance for other types of users illustrates the appropriation and multistability of technology over time and space (Silverstone & Hirsch, 1994; Verbeek, 2011, p. 9).

Also, the concept of 'scripts' (Wiebe E. Bijker & Law, 1992; Latour, 2005a), which is very popular among sociologist of technology have identified that the goals and intentions of technologies, as determined by their designers, are subject to change or modifications which are mostly unintended. These studies have raised the discussion on agency and intentionality, which are two key concepts in postphenomenology as well.

Postphenomenology also cracks down on traditional essentialist accounts of technology. For example, in the phenomenological sense and especially according to Heidegger, agency and intentionality is attributable to technology. This view was central in forwarding technological determinism which largely held a dystopian view of technology as a great "evil" that causes human suffering. An interpretation of technology which represents what Verbeek refers to as "common sense" views of technology:

> "The first is the *instrumentalist* view that technology is a neutral means to achieve human goals be they good or evil; the second is the *substantivist* conception that technology is not neutral but a determining and controlling influence on society and culture" (Verbeek, 2005, p. 11).

Heidegger, especially, held a view of technology mainly as a thing with inherent instrumentalist and substantivist capacities, a view that is popular referred to as technology with the capital "T". According to Ihde, it was this view that drew Heidegger

towards an ontology of technology that highlighted it's being and essence (Ihde, 2010). This way, Heidegger ascribed to technology its own agency and attached actual responsibility to technology. From the determinism perspective, technology is an actor within the general social framework and its presence has an effect on the nature and course of things. To an extent, Heidegger's essentialist view of technology cannot be blamed outright on him as his position on technology reflected the current conditions of his time when massive changes in the industrial economy characterized by growth in mechanization left a huge toll on social organization and quality of life. Hence, Ihde saw reason for Heidegger's strong dystopian view of technology as a force to reckon with in human society.

The major change in this traditional and essentialist view of technology in postphenomenology has come in the form of a reconceptualization of technology as possessing agency and intentionality, but one that is mediated. Hence, technology's role in society should be assessed in how it mediates reality and how this mediation is interpreted, and not by attributing intentionality to unconscious technological artifacts which is a contradiction (Verbeek, 2005, p. 109).

Another philosopher whose work is foundational to postphenomenology is Edmund Husserl. Ihde draws Edmund Husserl who was himself a student of Heidegger and held deterministic views of technology, which had close similarity with those of Heidegger. However, he revised his views on technology in his later works that reflected recognition of the non-deterministic nature of technology. According to Ihde, Husserl differed from Heidegger by resorting to intuition, experience and perception in

his explanation of materiality (Ihde, 1990, p. 35). Husserl's phenomenology focused more on scientific knowledge and he used Galileo as an illustration. Ihde criticized Husserl for understating the importance of physical instruments as primary sources of scientific knowledge, an approach which rids his work of a philosophy of technology (Ihde, 1990, p. 35). The implication here is that, technology is itself an object of knowledge and therefore it is inadequate to assign the source of scientific knowledge a purely non-technological status as Husserl did. This brought in hermeneutics as a subject in postphenomenology.

Postphenomenologists also engage in the revision of hermeneutics. Hermeneutics is derived from the Greek verb *"hermeneuein"* which simply translates into *"to interpret"* (Ihde, 1980, p. 325). Hermeneutics in the philosophy of technology has been discussed since Heideggerian times. According to Verbeek, Heidegger approached hermeneutics in order to portray "the role technology plays in the way human beings encounter and interpret reality" (Verbeek, 2005, p. 48). Owing to widespread critique, his hermeneutics required some more development in order to be deemed adequate in achieving the goal of explaining human-technology relations.

Ihde took a robust approach to hermeneutics in his book "Technology and the Lifeworld: From Garden to Earth" (1990) where he called for a shift in perspective regarding hermeneutics. In this same book, he used the term "cultural hermeneutics" to underscore the "ways in which cultures embed technologies" (Ihde, p.124). He indicated that there is more to be desired about human-technology relations at the cultural level. In a review of technology transfer, his own analysis of the experience of

"foreign" technologies in a traditional Guinean cultural context opened a window into how much technology as a cultural instrument can have different meanings under different cultural circumstances.

> "In response to each of these current concerns about technology, I propose a shift of perspective and, with it, a rephrasing of the questions. Such is the task of a cultural hermeneutics. I shall continue this inquiry as into technology and the lifeworld, now with a primary shift of focus to the macroperceptual field within which our bodily involvements take place" (Ihde, 1990, pp. 124-125).

Verbeek echoed the importance of hermeneutics in unravelling how reality is disclosed to people. He (re)conceptualized hermeneutics as "a perspective on technology in which the classic hermeneutical orientation toward texts is broadened to encompass things and artifacts" (Verbeek, 2005, p. 121). This implies that the questions that have been raised about technology, from time immemorial, still remain to be answered, albeit in a new way that takes into consideration interpretations. As a result, different ways of understanding how technology presents reality have emerged, which has resulted in the identification of multiple forms of relations.

Another direction that postphenomenologists are heading towards is empirical philosophy. The "empirical turn", as the catch phrase goes, signifies the movement in analytic philosophy of technology based on the view that philosophical analysis of technology can be done empirically by starting with the technology itself and then examining its role from chosen perspectives (Verbeek, 2005). Therefore, they advocate empiricism in philosophy of technology over traditional "armchair" philosophy of technology, but also emphasize the importance of interpretation as occurs in

continental philosophy. Finally, and more associated with my study is the concept of technological mediation in postphenomenology.

2.3 HUMAN-TECHNOLOGY RELATIONSHIPS

My aim, in this section, is not to moot a direct replacement of the determinists or instrumental view of technology with the technological mediation approach, but rather to explain the qualities of the mediation approach, which makes it a competitive counterpart of these approaches. Don Ihde's take on technological mediation is expressed via his postphenomenological arguments and critique in relation to the ideas of technology of Heidegger, Husserl and Merleau-Ponty. By critiquing some aspects and extending others, as well as molding new concepts, Don Ihde proposed a new way of viewing technology which, in general, should desist from the largely dystopian and determinist ideas held by earlier phenomenologists.

The mediation approach has retained focus on materiality. Verbeek referred to the technological mediation approach as "philosophical rethinking of philosophy and materiality" (Verbeek 2005, p. 10). On the whole, the focus on materiality in the analysis of technology has been retained in technological mediation theory and technical artifacts have come to be the main subjects of analysis in most mediation studies. Ihde consented that the notion of technology which he developed in his book "is as broad as possible while still retaining an emphasis upon its materiality" (Ihde, 1990). The study of artifacts is not entirely novel in philosophy of technology and the field of science, technology and society studies. In philosophy of technology,

especially in phenomenological and postphenomenological studies, much has been done to show the impacts that technology has on the human being with emphasis on materiality.

Furthermore, the mediation approach also examines the intentionality of technology and argues that technology is not neutral as opposed to the value-free conception put forward by some instrumentalists. According to Ihde (1980, p. 332), intentionality is central in the phenomenological theory developed by Husserl and intentionality is also regarded as “a core concept” in understanding human-world relations (Verbeek, 2008a, p. 388). Ihde defines it as the “referential or directed nature of consciousness”, “the foundational correlational rule of phenomenology by which any area of possible knowledge whatsoever is located and circumscribed” (Ihde, 1980). Within the framework of intentionality, there is a subject and object which both correlate and are interdependent. Verbeek, for example, explains technological intentionality as “directed at specific aspects of reality and help to shape human perceptions and interpretations accordingly” (Verbeek, 2009c, p. 66). Therefore, a theoretical discussion about the impacts of technology as is the case in this study implicates a considerable amount of technological intentionality in its analysis.

In addition to the above-mentioned identifiable aspects of the mediation approach, it also delves into the analysis of human-technology relationships. It is this feature of the approach which orients it to anthropology of technology and the human being. Within the current environment that humans find ourselves, it is hard to imagine any kind of activity that does not involve technology or some technological artifact making it

necessary to examine the extent to which technology defines our understanding of the human being, and vice versa. However, even when almost all human activity involves technology, it still raises the question of how much of a role one type of technology play – for example, in what we think or do. Consequently, there is an enduring appetite in finding out the exact role that a specific technology plays in a particular context and mediation approach has been the approach used in unraveling different forms of relations that involve technology and the human being. Below, I discuss forms of human-technology relationships identified by Don Ihde and Peter-Paul Verbeek.

2.3.1 FORMS OF HUMAN-TECHNOLOGY RELATIONSHIPS

A very familiar terminology in technology mediation theory is *"human-technology-world relations"* which came in at the time that Don Ihde raised interest in the impact of technology in society. As Ihde put it:

> "The task of a phenomenology of human-technology relations is to discover the various structural features of those ambiguous relations. In taking up this task, I shall begin with a focus upon experientially recognizable features that are centered upon the ways we are bodily engaged with technologies. The beginning will be within the various ways in which I-as-body interact with my environment by means of technologies" (Ihde, 1990, p. 72).

According to Ihde (1990), there exist a form of relation between humans and the world around us which can be denoted as "I----World". Within this "I----World" relationship are two elements which equates it to a dyadic relationship. Also, within this *dyadic* relationship, there is no representation of technology as it only depict the relation between the human being denoted as "I" and their world. However, the dyadic relationship between the human and the world transitions into a *triadic* one with the introduction of technology "I---Technology---World". It is this triadic relation which

manifests technology as an extra variable, and a mediating one as such and represents the basic form of technological mediation. Based on this foundational theorem of technological mediation, Ihde identifies different forms of mediation relations, to which Verbeek has added two more. Below is a tabular summary of the different variants of technological mediation according to (Ihde, 1990) and (Verbeek, 2008a) and their schematic representation. The arrows indicate intentionality whilst the dashes indicate relations (Verbeek, 2008a, p. 390).

Table 1: Summary of Human-Technology Relationships

Author	Type of Relation	Depiction of Relation
(Ihde, 1990)	Embodiment	(human – technology) →world
	Hermeneutic	Human → (technology – world)
	Alterity	(human → technology (– world)
	Background	Human (– technology – world)
(Verbeek, 2008a)	Cyborg	(human/technology)→ world
	Composite	Human → (technology → world)

Source: Ihde (1990) and Verbeek (2008a)

EMBODIMENT

In his book "*Technology and the Lifeworld" (1990),* Don Ihde outlined the "embodiment relations" which explains the "detachable" and "quasi-transparent" relations between humans and technology (Ihde, 2008a, p. 398). Embodiment is considered an activity which has to be "learned" or "constituted" (Ihde, 1990, p. 73). The embodiment relation is depicted as (I–technology) →world, which shows the symbiosis of technology and the human in advance of a view of the world. As Verbeek puts it "in these relations, human beings take technological artifacts into their experiencing, and thereby broaden

the area of sensitivity of their bodies to the world. An example of the embodiment relation is the wearing of eyeglasses" (Verbeek, p. 125). The example of the eyeglasses used by Verbeek does not only point to the amount of intimacy between technology and the human being in embodiment relations, but also how transparent the technology is in this type of relation. A similar example of this type of human technology relation is the male condom which comes transparent in its relation with the man wearing it.

HERMENEUTIC

The hermeneutic relations is depicted as "I→ (technology–world)". It also follows the fundamental triadic form, however, the relationship is different as it portrays the human in a non-embodied position from where they interpret the world via technology. In the hermeneutic relation, the human being understands the world by making sense of how it is presented to them *through* the technology, which implies that the technology presents a particular type of representation of the world to the human being. The technology becomes the human being's window into the world, however, it is important to note that the technology is a means by which the world is perceived and not the world itself. Again, Verbeek illustrates the hermeneutic relation with the example of the thermometer which is read for an understanding of temperature (Verbeek, 2008a, p. 389).

ALTERITY

The alterity relation is depicted as "Human → technology (- world)" and refers to the kind of interactive exchange which takes place between humans and technology.

Within this relation, humans gain experience by virtue of technology's "terminus" (Verbeek, 2008a, p. 389). An example is the interaction with Automated Teller Machines (ATMs).

BACKGROUND

The background relation is depicted as "Human (– technology – world)". In the case of background relations, there is a rather indirect experience of technology. The only channel by which humans relate with technology in this type of relations is because both share the same context. Example is the "automatic switching on and off of the refrigerator" (Verbeek, 2008a, p. 389).

CYBORG RELATION

Verbeek added two relations (cyborg and composite relations) on the basis of the concept of intentionality identifying three types of intentionality: *technologically mediated intentionality*; *hybrid intentionality* and; *composite intentionality* (Verbeek, 2008a, p. 387) which highlights the contemporary practices of human-technology fusion that involves a direct merging of the human body and technology as is the case in some enhancement and transhumanist practices. According to Verbeek, there are "technology relations in which the human and the technological actually *merge* rather than "merely" being embodied" (Verbeek, 2008a, p. 391). Verbeek's account of a "cyborg relation" not only brings into understanding the view of an existing reality, but also raises doubts into Ihde's idea of "technofantasy" (Ihde, 2008a) which put to reserve the possibility of direct human-technology fusion. Bionic organisms are examples of this relation depicted as "(human/technology) → World".

COMPOSITE RELATION

The composite relation is based on *composite intentionality* which is explained as "a form of intentionality which results from adding technological intentionality and human intentionality" (Verbeek, 2008a, p. 393). It combines both the human and technology in a bi-directional transaction and exchange of intentions. It is depicted as "Human → (technology → world)".

2.3.2 TECHNOLOGICAL MEDIATION AS ILLUSTRATED IN SCIENCE PRAXIS

An example of mediation analysis is how technical artifacts mediate scientific knowledge. This is an aspect of mediation which has received some more analysis and explanation by Ihde in his book "Expanding Hermeneutics: Visualism in Science (Ihde, 1998) where he argues that "much of science praxis is functionally hermeneutic" (Ihde, 1998, p. 4). The central theme in his (postphenomenological) analysis of science practice, as presented in the book, is that technology has value in how reality is revealed to us - in other words how we experience and interpret reality. His analysis also attempted to address the "Hermeneutic-Positivism (H-T) Binary" problem which has been a dogma clung onto by both natural and social science researchers.

According to Ihde, hermeneutics is an "interpretive activity", and therefore goes beyond the two categories in the H-T Binary (Ihde, 1998, p. 2). Ihde underscores the importance of hermeneutics in science as a mechanism for interpreting reality and develops a "material conception" based on technological mediation concept to support it. According to Verbeek "traditionally, hermeneutics was understood to involve the interpretation of texts as well as reflection on the process of interpretation and its

conditions. Ihde, however, develops a more material conception of hermeneutics." (Verbeek, 2005, p. 141). Hermeneutics has often taken a back sit as a non-objective, non-scientific and value-laden method of analysis. It is mainly the humanities that has kept hermeneutics alive. According to William Outhwaite:

> "The word hermeneutics refers, of course, to the Greek messenger-god Hermes, and reflection on the problems of interpretation and criteria for the truth, validity or adequacy of interpretations goes back to ancient Greek thought in the European tradition and a similar historical distance in the other world civilizations. This pre-history of hermeneutics was revived in the philological criticism of classical texts in the Renaissance, the interpretation of Roman Law, the interpretation of the Bible in Christianity (especially Protestantism) and the philosophical analysis of texts" (Outhwaite, 2007, p. 459).

Using Galileo's telescope as an example, Ihde explains how important technology is in complementing and enhancing human capacities at understanding the world in which we live. Ihde notes that within science praxis, technological mediation can follow either a "strong program" or "weak program" (Ihde, 1998). According to Verbeek:

> "In a weak program, instruments are conceived as forming an interface between science and the reality it studies, codetermining how that reality is to be interpreted. A strong program, which Ihde ultimately advocates, goes a step further and views instruments as actually constituting the objects studied by the sciences and therefore as codetermining the content of scientific knowledge" (Verbeek, 2005, p. 141).

Obviously, my research is not about scientific praxis, however, this sort of interpretation, if taken out of the context of science and applied to a technology that people encounter in their daily routines such as technology for development, the weak program can be interpreted as a technology serving as a point of contact between people and their world, whiles in the strong program, the technical artifact can be viewed as part of the reality that occurs to people. Furthermore, it also allows to

explore the argument that technology does not only mediate “visualism in science” but also capable of mediating “visualism in society”. More precisely, my research will argue for, and attempt to provide evidence to the fact that technology mediates how we see or experience things in society. This will not only transpose technological mediation from the context of science (as demonstrated by Ihde) to a sociocultural context (in the case of the Mechanized Water System), but also bring more insight into how technology plays a role in how perceptions and practices in society take shape and the place of interpretations in this process.

2.3.3 SOME GAPS IN THE MEDIATION APPROACH TO TECHNOLOGY

Generally, progress is still being made in postphenomenology research and it is still pre-mature to make claims of a specific, well-developed and elaborate technological mediation theory. Consequently, one of the major gaps in the mediation approach is the amount of empirical research available on the concept. For example, there is the lack of actual empirical insight into how the framework works (Kaplan, 2009b), a critique well-acknowledged by Verbeek (Verbeek, 2009b).

Also, the range of technological mediation research is not comprehensive enough to cover all aspects of human-technology relationships. Some philosophers, such as Ihde and Verbeek, have been at the forefront of investigations in anthropological dimensions of technology and human, albeit in an individualized manner. This is the case in their studies of the kind of relations (as discussed above) that exist between human beings and technology in what can be labelled “micro-mediation” characterized

by individual level of engagement with technology (Ihde, 1979b, 1979c, 2010; Illies & Meijers, 2014; Verbeek, 2005, 2008a, 2008c, 2012).

There is yet to be a clear attempt to explain mediations beyond the individual-technology relationship to a group-technology relationship. The limitation becomes even more evident when one attempts to understand the mediating role of technology in a larger sociocultural context. In the next section, I attempt to construct a theoretical framework based on the technological mediation approach. My framework specifically builds on the existing propositions of mediation as outlined above and explore mediations in sociocultural contexts. Hence, this framework is not built independent of the mediation approach, rather, it takes inspiration from it and extents it into an actual social and cultural context in which technology exists and relates with human beings. As noted by a reviewer of Verbeek's mediation approach:

> "Unfortunately, Verbeek's work, like Latour's previously, devotes too much energy developing the framework, and not enough time applying it, so the reader can see this mediation in action. This emphasis of exegesis over application weakens an otherwise solid contribution to the philosophy of technology" (Galusky, 2008),

Therefore, part of the energy in this study is devoted to understanding an actual technological artifact and its mediations drawing from what has already been theoretically argued by the proponents of the mediation approach.

2.4 THEORETICAL FRAMEWORK FOR "SOCIOCULTURAL MEDIATION"

Theory serves as a foundation of research and a way for the researcher to orient themselves in studies. Thus, it is important to be establish a framework in this study in

order to be guided towards aspects of the phenomenon under studied. This framework is constructed with the aim to explore technological mediation in sociocultural contexts or what I term as "sociocultural mediation".

Sociocultural studies is inalienable in philosophizing about technology because society and culture are among the contexts within which most technologies are experienced. According to Verbeek, mediation theory has the ability to reveal how a "technological artifact-in-use has a social and cultural impact" (Verbeek, 2009, p. 256) and can adequately addresses the materiality of technology as it exists in society in a holistic manner that cuts across all aspects of society including politics, social structure, technological design and policy-making. Within sociocultural contexts, we can examine how the use of technology generates new forms of relations in society and how "users and their environment, in which actions, decisions, experiences and interpretations get shaped in a technologically mediated way" (Verbeek, 2009, p. 253). This comes against the backdrop of attempts to overcome relativism in the interpretation of technology. As Verbeek indicates:

> "From the postphenomenological perspective, reality cannot be entirely reduced to interpretations, language games, or contexts. To do so would amount to affirming the dichotomy between subject and object, with the weight merely being shoved to the side of the subject. Reality arises in relations, as do the human beings who encounter it. Only in this sense is postphenomenology a relativistic philosophy—it finds its foundation in relations" (Verbeek, 2005, p. 113)

Hence, this framework cautiously avoids the dichotomy between subjects and objects in the analysis of technology in socio-cultural contexts.

In framing for research on technological mediation in sociocultural contexts, concepts such as the *lifeworld*, *experience, interpretation*, and *interrelational ontologies* come to mind. The term "lifeworld" was first used by Edmund Husserl in his piece "Crisis in European Science and Transcendental Phenomenology" (1936), however, it has been revised and popularized in contemporary postphenomenology by Don Ihde in his book "Technology and the Life World: From Garden to Earth" (Ihde, 1990).

Experience is a component of the lifeworld, and human beings and our world as it occurs to us can be analyzed "in terms of artifacts" (Verbeek, 2005, pp. 121-122). According to Ihde, human "experiencers" can gain access to their world through technological mediation and the presence of technology "reveals" hitherto unreachable human potential in a phenomenological sense (Ihde, 2011, p. 111). Also, things are inseparably connected to their contexts through the process of engagement and "the experience of a thing is always and also a bodily and social engagement with the thing's world" (Kaplan, 2009a, p. 57).

Technological mediation does not occur in a vacuum and within the lifeworld, there are not just mediations, instead there are mediations of something which Don Ihde refers to as *"interrelational ontology"* (Ihde, 2009, p. 23), in the similar fashion as Edmund Husserl's catchphrase that "all consciousness is consciousness of something". Don Ihde's explanation in the quotation below sums up the two:

> "In both pragmatism and phenomenology, one can discern what could be called an *interrelational ontology*. By this I mean that the human experiencer is to be found ontologically related to an environment or a world, but the interrelation is such that both are transformed within this relationality" (Ihde, 2009, p. 23).

Ihde's reference to "an environment or a world" is not so distant from his usage of the "lifeworld" in other texts (Ihde, 1990, p. 2).

I find the recognition of the exchange between the human being and other elements in their environment or world the main window through which we can empirically investigate the mediation relations between technology and the human being. Hence, I do find it very needful to pay attention to *what* people experience or relate with which so that we may identify which aspects of human experience and relationality undergo transformations in the human-technology relationship and *how* such transformations occur within technological mediation. That is why it is necessary to identify the "neoma" and "neosis" of mediation in a sociocultural context. According to Ihde:

> "Put most simply, "neoma" is *that* which is experienced, the *what* of experience, the "object-correlate." "Neosis" is the way in which the what is experienced, the experiencing or act of experiencing, the "subject-correlate." Thus, there is no "neoma" without "neosis" (there is nothing which is present as evidenced unless it is present to experience), and there is no "neosis" without a "neoma" (no act of experience without that toward which it is directed)" (Ihde, 1998, pp. 16-17).

For example, technological mediation theory has already served as perspective in the study of phenomenon which can be regarded as neoma within the context of interrelational ontologies. For example, the different *neoma* such as power (Bantwal Rao et al., 2015), ethics (Anderson & Anderson, 2011; M. Boenink, 2010; Marianne Boenink, 2012; P. E. Brey, 2012; Hansson, 2005; Hedgecoe, 2010; Rychetnik, Carter, Barratt, & Irwig, 2013), and morality (Kroes & Verbeek, 2014a, 2014b; Pols, 2013; Stemerding, Swierstra, & Boenink, 2010; Verbeek, 2008b, 2008c, 2009c, 2011) have

been dealt with by the respective researchers. I shall explore the interrelational ontologies (neoma and neosis) of the Mechanized Water System in Sangul.

2.4.1 LINKING THEORY WITH TECHNOLOGY FOR DEVELOPMENT

In this section, I attempt to respond adequately to the question "why is technology for development a subject in this research and how does it relate with the subject of technological mediation in sociocultural context?" The response to this question comes in two folds: first is the relevance of technology for development to the empirical case under study in this research; and second is the relevance of technology for development to the technological mediation concept discussed in this research.

2.4.2 LINKING TMT TO THE MECHANIZED WATER SYSTEM

The technological mediation approach helps to put the Mechanized Water System in perspective or, as Verbeek puts it, different "ways of seeing" (Verbeek, 2005, p. 137). This also resonates with the extract below taken from Verbeek's reply to reviewers of his book "What Things Do: Reflections on Technology, Agency and Design" which sums up the importance of context in postphenomenological research in general and this material hermeneutic framework in particular:

> "What Things Do, therefore, aims to show that the impact of technologies is not exhausted by the impact of their conditions, and that their social and cultural impact cannot be grasped in terms of ''Technology.'' The impact of technologies emerges from the often unexpected contexts and relations with human beings in which they function, which become visible in a more empirically oriented approach. In such contexts and relations, things are appropriated and ''enacted'' in specific ways. And on the basis of the contextual identity they develop, they help to shape human actions and experiences. When people use a technology, this technology starts to organize a relation between users and their environment, in which actions, decisions, experiences and interpretations get shaped in a technologically mediated way…. And, actually,

> this is not very far from the historical-materialist idea that society is not primarily driven by immaterial ideas but also by material entities and arrangements. Not only ideas have consequences—artifacts have consequences too. As conditioned entities, technologies condition human life" (Verbeek, 2009b, p. 253).

This is especially of very good fit with *technology for development* – the broader context of my research – where there is a close relation between technology and other social phenomena as reflected in the perceptions and practices of the people. Hence, for this method to properly address the Mechanized Water System in its context, it must be able to take into consideration the totality of the Sangul community where it is implemented.

2.4.3 A BACKGROUND TO "TECHNOLOGY FOR DEVELOPMENT"

The use of technology in development practice is increasing and comes concurrent with the increased interest in science and technology studies. But how much understanding is there of technology itself and, in effect, how close can we get to understanding the true role of technology in development? Needless to say, it is easy for some to refer to technology as means to ends in development because it provides certain affordances (Gaver, 1991) which are visible to the eye when introduced in a context. Nevertheless, understanding the role of technology, and in this case, in the context of development transcends that which appeals to the eye.

An important detail to take into consideration here is that *technology for development* is extracted from to a wider construct referred to as "science and technology for development" (Smith, 2009). "Science and technology for development" emerged as a roadmap for stirring up development in less developed countries in the early 1950s.

It is often mentioned that the movement came into being following calls by United State President Harry Truman for the application of science and technology for development in poor countries:

> "…we must embark on a bold new program for making the benefits of our scientific advances and industrial progress available for the improvement and growth of underdeveloped areas" Truman (1949)

Later in 1979, the first United Nations Conference on Science and Technology for Development was held in Vienna, Austria, where a program of action (United Nations, 1979) was adopted. This heritage in Science and Technology for Development already gives *technology for development* some form of identity and meaning to associate with – what I wish to refer to as *foundational meanings of technology for development.* The foundational meanings of *technology for development* or, in the least, its core significance can be drawn from the philosophies of the initiators of the Science and Technology for Development movement as exemplified in Truman's speech and the United Nations' conference. From these earlier times, there has only been but a steady increase in the use of technology (artifactual and non-artifactual) for development.

Many who use technology for different purposes can testify that the outcomes of technology may sometimes differ largely from initial expectations which influences the classification of technological outcomes in terms of successes or failures (Geels & Smit, 2000). As a result, the design and implementation of *technology for development* is constantly developing innovative ways of ensuring that the prospects of technologies used for development are successful (Wicklein, 1998). Irrespective of the adoption of innovative designs and implementation measures, some technologies still

fail. This leads one to question the validity of the approach that underlies the design and implementation of these technologies. *Technology for development*, according to Smith (2009, p. 4), "has some discernible problems regarding successes and failures". A distinction can be made between failures resulting from technical and engineering malfunctions on the one hand, and non-technical failures mainly resulting from social and cultural resentment on the other hand (Carayon, 2006; Margolis, 2006; Quarantelli, 1997). As such, it is important to identify how the non-technical aspects of technology weighs in on the general success or failure of the technology.

There have been considerable reflection on technologies designed for the purpose of development. Majority of these studies are more sociological or economic studies and come in the form of science, technology and society (STS) studies (Sismondo, 2011). Also significant is the emergence and use of concepts such as "appropriate technology" (Basu & Weil, 1998; Bowonder, 1979; Holland, 1989; Teitel, 1978; Trak & Mackenzie, 1980; Wicklein, 1998), "capability approach" (Sen, 1985), "technology transfer" (Glass & Saggi, 1998; Ihde, 1990) among others, which have added some understanding and introduced new directions in studies of technology and society with the aim to ensure that implementation of technologies are useful, acceptable and sustainable in developing parts of the world. At a theoretical level, these concepts seem to have one thing in common – that technology is *"scripted"* (Akrich, 1992). The concept of *script* argues that technology often inhabit certain commands that are predetermined and molded into it by designers (Akrich, 1992). These scripts come in various forms which society (people) do "de-script" by engaging, or relating with them.

2.4.4 FOUNDATIONAL RESEARCH ON TECHNOLOGY FOR DEVELOPMENT

There are already some studies of technology which fall within the bracket of sociocultural studies although the researchers involved do not claim them as such. Majority of such studies are contacted within anthropology and other forms of human studies. An example is the study by Marianne de Laet and Annemarie Mol in their article "The Zimbabwe Bush Pump: Mechanics of a Fluid Technology" (2000). Their study was an investigation of "the intricacies of an admirable water pumping device – the Zimbabwe Bush Pump 'B' type – so as to find out what makes it an 'appropriate technology'" (de Laet & Mol, 2000, p. 225). Their study found that the technology functioned fluidly within the sociotechnical context in which it found itself, and that the design of the technology itself had undergone some adaptations over time in response to contextual preferences. In their somewhat romantic narrative of the interaction between the physical characteristics of the technology and rural Zimbabweans, they made a significant mention of the influence of some authorities within the sociocultural setup, specifically the *nganga* who is referred to as a traditional authority. They make a brief allusion to the importance of the *nganga* without whom the boring of water pumps faces problems and result in failure (de Laet & Mol, 2000, p. 234). Although, they do not elaborate much on how the cultural aspect of the human-technology relations involving the "nganga" works out, they do point out the kind of relationship that technology can have with other social and cultural elements in its context.

Another example of a sociocultural study involving technology is Schaniel's work on the Maori tribe and how they appropriated iron artifacts (Schaniel, 1988). She noted

that adopting technologies does not necessarily include the adoption of the "system of logic" within which the technology was produced. Her conclusions are summed up by Brian Pfaffenberger as follows:

> Schaniel concludes that "the process of adopting and adapting introduced technology ... does not imply that introduced technology does not lead to change, but the change is not pre-ordained by the technology adapted....The process of technological adaptation is one where the introduced technology is adopted to the social processes of the adopting society, and not vice-versa" (89:496-98)" (Pfaffenberger, 1992, p. 511).

What is notable in this conclusion by Schaniel and relates to the concept of mediation is how her observations of the appropriation of the iron implements were made within the context of farming among the Maori. What this suggests is that there was a "mediation of farming" among the Maori regarding their appropriation of the iron implements. This reinforces the essence of understanding the interrelations ontologies in technologically mediated sociocultural contexts in by observing the neoma being mediated and neosis involved in the mediation. It is from these ontologies that we can see the actual changes that reflect technological mediation. This is also why the analysis of the Mechanized Water System as *technology for development* and its mediations within the sociocultural context of Sangul is well at hand.

2.5 CONCLUSION

This chapter has explored and discussed existing literature on technology and its role in different situations. Also, a framework to guide the analysis of technology in sociocultural contexts was developed based on the technological mediation theory. This provides a solid theoretical basis to launch an empirical study of the Mechanized

Water System as well as an orientation from which to analyze its role in Sangul in the chapters ahead.

CHAPTER 3

RESEARCH METHODOLOGY

3.0 INTRODUCTION

This study adopted a systematic research plan comprised of specific techniques and corresponding rationale for which each of them was adopted. Overall, the study combined both descriptive and analytic techniques which is in line with postphenomenological research methodology. Don Ihde explains that philosophical investigations of technological artifacts may begin with a descriptive analysis of the technology and then descend into a hermeneutic analysis of the technology (Ihde, 1990, p. 2). Therefore, the techniques adopted herein for analyzing the Mechanized Water System in Sangul follow standard research process as well as incorporate measures that are within the scope of postphenomenological research.

3.1 CASE STUDY DESIGN

The entire research process can best be described as a case study. The case study design is a methodological approach which allows researchers – especially behavioural and social science researchers – to employ different techniques in obtaining and analysing data (Hamel, Dufour, & Fortin, 1993). Although the case study is not itself a technique for gathering data, it involves methods which allow systematic gathering of "information about a particular person, social setting, event, or group to permit the researcher to effectively understand how it operates or functions" (Berg, 1989, p. 225). This type of design is adopted in this study because it fits the main goal

of the study which is to study the phenomenon of technological mediation in sociocultural contexts in depth by focusing on the Mechanized Water System as a single case. Also, it is known that the case study method has benefits such as paving the way for the discovery of new knowledge and understanding because “it can easily serve as the breeding ground for insights and even hypothesis that may be pursued in subsequent studies” (Berg, 1989, p. 231).

The main limitation with this approach is that much of its conclusions my not be generalizable as a result of the focus on a case with peculiar characteristics, making objectivity seem a far-off possibility. Nevertheless, this study took this limitation in account and adopted two key measures to address it. First, much of the conclusions from this study have foundations in existing concepts and theories which emerged from other studies. Second, this study limits the amount of dependence on subjective factors to draw conclusions and instead adopts an intersubjective approach in which different experiences and opinions are cross-examined against one another. Each outcome is treated with considerable scepticism and critically evaluated from the perspective of the theoretical framework.

Furthermore, using this method is deemed appropriate because it permits a more detailed study and analysis of the Mechanized Water System in its sociocultural context. It helps to gain a holistic understanding of the Mechanized Water System in its setting because it is a method for studying phenomenon in depth rather than breadth and can be applied in “a careful and complete observation” of social units such as persons, family, institutions, cultural groups or entire communities (Kothari, 2004,

p. 113). Also, it is the choicest method that will guarantee a successful analysis of this technology from a philosophy of technology perspective. This is especially important because:

> "Postphenomenology retains and emphasizes the use of phenomenological variations as an analytic tool, and in practice postphenomenology takes what is commonly now called ''an empirical turn,'' which deeply analyzes case studies or concrete issues under its purview" (Ihde, 2008b, p. 1).

Hence, adopting the case study design is spearheaded by postphenomenological concepts that provide a guide to the empirical observations carried out in a real world setting, the interviews and literature.

3.1.1 QUALITATIVE TYPE OF RESEARCH

This research is largely, if not entirely, a qualitative type of research. Qualitative research, as opposed to quantitative research, is distinguished by its reliance on non-numerical data. It is no secret that there is some amount of disagreement among researchers (especially between positivists and anti-positivists) about the adequacy of qualitative, quantitative, or mixed methods of data collection and/or analysis. This has, however, not overshadowed the well-recognized strength in qualitative research which is part of the reason why it is adopted here. According to Brosziewski (2006), qualitative research provides detailed description and analysis of the quality, or the substance, of the human experience" (p.7) and equally shares honours with other types of research as a viable approach for observing reality empirically. Qualitative methods have also become rigorous, systematic and logical to an extent that researchers who adopt them, as I do here, adhere to standards for ensuring validity

and non-bias. Some of the standards maintained in this study include setting clear questions, objectives, providing justification for the research as well as the technological mediation approach to guide the process.

3.1.2 AREA AND SCOPE

Research does not occur in a vacuum, neither does it extend over all boundaries. This study's area is the Sangul community with their Mechanized Water System as the main technological artifact in focus. The empirical scope is therefore limited to the Mechanized Water System in Sangul whilst the theoretical scope is the technological mediation approach in postphenomenology.

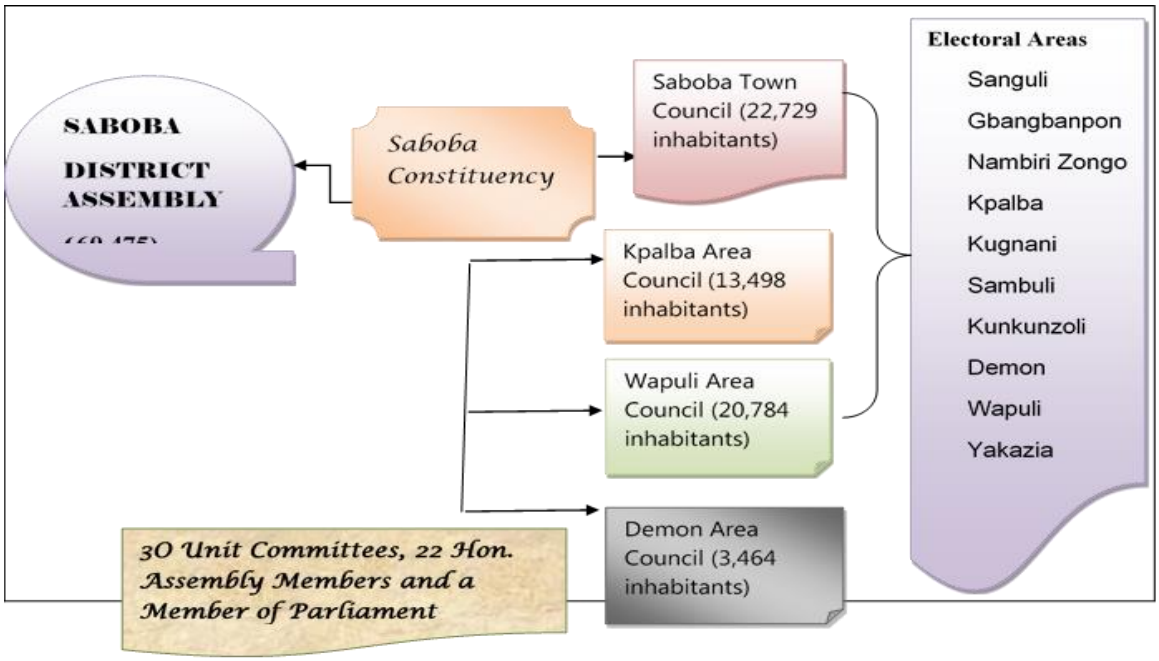
The Sangul community is located in the Saboba District, Northern Region of Ghana, West Africa. Locally, 'Sangul' is how the community is called, however, it is often spelt differently (for example 'Sanguli', or 'Samguli') by organizations that come into contact with the community. According to traditional folktale, the name *Sangul* is derived from two words: "nsaan" which means "road", and "guul" which means "below". Literally, Sangul means "the road below". Other writers have translated it as "road under" (WVG Saboba ADP, 2011).

Legend has it that one of the first settlers in the community was a hunter who discovered a thick forest in the area and made a path through it. After a while, trees fell from the two sides of the path and got interlocked. As a result, people were required to bend at the interlocking point when using the path, and that was how the name Sangul was formed (ibid). Most of the inhabitants are Konkomba by ethnicity and the

predominant occupation is farming and animal husbandry. Majority of the people engaged in small and medium-scale agriculture and do minor activities such as trading, fishing, fishing, hunting, dress making. There is a mix of African Traditional Religion, Christianity, and Islam in the community (ibid).

Administratively, the community runs a traditional chieftaincy system, but Sangul is also under the jurisdiction of the Saboba District Assembly (SDA). Below is a structure of the SDA and it various units. Sangul is an electoral area under the

Figure 1: Saboba Local Government Structure



Source: Saboba District Assembly (2006)

3.2 DATA COLLECTION METHODS

3.2.1 SAMPLE CHARACTERISTICS AND INTERVIEWS

The interview method is known to be a one of the basic methods for collecting data which "involves asking people questions and receiving answers from them"

(Brosziewski, 2006)(p.14). As (Brosziewski, 2006) puts it “the interview format assumes that human beings share a common experience, which any random member of society can articulate when asked to do so” (p.15), a process termed “the democratization of opinions” (Gubrium and Holstein 2002:4).

One of the main reasons why I used this method was because of the interpretative nature my study. As indicated earlier, this is a qualitative type of study and I am interested in the experiences of the Mechanized Water System in Sangul. However, the procedure for selecting interview participants was not random, neither was the rationale for adopting the interview method based solely on the assumption that the participants will provide information which is representative of the entire community’s experience.

The sample selection method was based on the purposive sampling method also known as judgemental sampling (Berg, 1989). According to (Berg, 1989) researchers who adopt the purposive sampling method may either use their “special knowledge or expertise” to select a sample which represents the population, or conduct “field investigations on some group, in order to ensure that certain types of individuals or persons displaying certain attributes are included in the study” (p.32). I did combine these two approaches in selecting the sample I interviewed.

First, I have special knowledge of the Sangul community because I hail from the Saboba District and I am Konkomba by tribe as well. Further, I worked with World Vision as a volunteer and especially participated in the implementing some of their programs in the community. For example, I participated in collecting data for preparing

the Community Disaster Preparedness Plan (CDPP) of Sangul, and provided support to the Saboba ADP implementation team to train members of the WASH Committee.

Second (and related to field investigations), I purposively selected participants from three different categories: actual inhabitants of Sangul, development professionals in the Saboba ADP, and officialI from the Saboba District Assembly. The common factor among these three categories is that they have a material relation with the technology. As a result, the range of people to select from was reduced to those who implemented, use, monitor, or maintain the Mechanized Water System. This made the sample a diverse one including inhabitants of Sangul, development professionals from the NGO (World Vision, Saboba ADP), and government personnel from the District Works Department of the Saboba District Assembly.

In another light, my sample includes two groups of participants: those internal to the sociocultural setting of Sangul, and those external to it. This was done in order to have a balance between people who relate with the technology as a result of their membership of Sangul and those who relate with the technology but are not members of the community. I also considered having a balance between male and female participants important as a result of the gender-relevance of the technology. The table below summarizes the characteristics of the sample I interviewed. It is important to note that I could not interview all of the persons I planned to interview due to time constraints. In total, 9 out of the 13 people sampled were successfully interviewed.

Table 2: List of Interviewees

Interviewee	Description	Sex	Medium	Remarks
Sangul Community Members				
1	Uninkpel	Male	Skype	Interviewed
2	WASH Committee Chairman	Male	Skype	Interviewed
3	Hygiene Inspector	Female	Skype	Interviewed
4	Treasurer	Female	Skype	Interviewed
World Vision Development Officers				
5	Project Manager, WVG Saboba ADP	Male	Skype	Interviewed
6	Sponsorship PO, WVG Saboba ADP	Male		Not Interviewed
7	Health PO, WVG Saboba ADP	Female	Skype	Interviewed
8	WASH PO, WVG Saboba ADP	Female	Skype	Interviewed
9	DM&E Coordinator, World Vision Ghana	Male		Not Interviewed
10	Logistics	Male	Skype	Interviewed
GRWP Project Engineers				
11	Project Manager, GRWP	Male		Not Interviewed
12	Technical Installation Team	Male		Not Interviewed
District Assembly Development Agent				
13	Dept. of Works, Saboba District Assembly	Male	Skype	Interviewed

Source: Mpuan (2015)

3.2.2 INTERVIEW TYPE AND INSTRUMENT

The type of interview I conducted was unstructured. According to Brosziewski (2006), the unstructured interview type is less stringent as compared to a structured interview type, which allows researchers to have a good rapport with interviewees and keep questions and responses open-ended and free-flowing (p. 20). Thus, I designed an interview guide with open-ended questions as research instrument (Wilkinson & Birmingham, 2003). This type of unstructured guide and questions was important for in-depth interviews with participants.

Two additional factors which facilitated by in-depth interview with interviewees were language and medium of interview (Skype). All interviewees from the Sangul community did not speak English but Likpakpaaln (local dialect). Thus, my conversation with them was in Likpakpaaln which happens to be my local dialect as well. For the remaining interviewees, English was our language of communication. Skype was my main medium of communication with the interviewees. Some of the conversations were video-enabled, allowing us to have a face-to-face interaction whilst some were only voice-enabled.

For the video-enabled interviews, it was possible to see and exchange visual cues whilst the voice-enabled interviews were no different from a typical telephone interviews. Telephone are known to lack non-verbal cues that can aid researchers in understanding their interviewees, nevertheless, this type of interview can be effective in data collection (Berg, 1989). In my case, lack of face-to-face contact with the voice-only interviews neither posed a significant challenge in creating rapport with interviewees and understanding them nor affected the quality of the interview because we already know each other through my time with World Vision, Saboba ADP as a volunteer. This is supported by Berg (1989)'s reference to (Rubin & Rubin, 1997) that "qualitative interviews are also quite productive when they are conducted among people with whom the researcher has already conducted face-to-face interviews, or with whom they may have developed a rapport during fieldwork" (p.82).

Further, I also employed the services of a research assistant whose sole role in the process was restricted to arranging for participants to meet with me, taking pictures of

the water system, and my contact with participants. I did not delegate any roles regarding research content or actual data collection to the research assistant.

3.2.3 LITERATURE

Secondary data was an important element in obtaining adequate knowledge of the research case. I primarily relied on books as my source of secondary literature. Next to books were articles and papers I accessed from online databases such as Google Scholar, Science Direct, Jstor, among others. The criterion for accessing the articles was keyword search. Also, I gained access to existing information on the Mechanized Water System and Sangul from the development agency and the District Works Department. Below is a list of main books used in my literature review.

Table 3: List of Main Sources

Author	Year	Title	Relevance
Ihde, D.	(1990)	Technology and the Lifeworld: From Garden to Earth: Indiana University Press.	On Technological Mediation Theory
Ihde, D.	(1998)	Expanding Hermeneutics: Visualism in Science: Northwestern University Press.	On Hermeneutics
Verbeek, P.-P	(2005)	*What things do : philosophical reflections on technology, agency, and design*. University Park, PA: Pennsylvania State University Press.	On technological mediation theory and hermeneutics
Smith, J.	(2009)	*Science and technology for development*: Zed Books.	On technology for development
Sismondo, S	(2010)	*An Introduction to Science and Technology Studies*	On Science and Technology Studies

3.3 DATA ANALYSIS METHODS

According to Berg (1989), data analysis is one of the most difficult stages of research. It is at this stage that researchers discuss information, ideas, theories and concepts in order to make meaning and draw conclusions. For this reason, "theory plays a foundational role in how qualitative data is analyzed" (Brosziewski, 2006, p. 83). The analysis in this research, was mainly done in the frame of technological mediation which I outlined in the second chapter and was focused on answering the research questions raised as well as attaining the objectives outlined in the first chapter. The procedure involved transcribing interviews, generating data codes for summarizing information, reducing the amount of text from various sources of data, explaining the relations between information and drawing informed conclusions. These steps were also necessary in ensuring the validity of the information obtained from the different sources of data.

The analyses brings more insight into the role of technology in sociocultural contexts. The perceptions that people that the people of Sangul have about their world and the transitions which have occurred in these perceptions relating to their experience of the technology was particularly analyzed. Also, the practices within the community (some related to the perceptions of the people) and the changes in these practices have also been identified and examined from the mediation perspective. The fifth (and final) chapter is dedicated to building the concept of technoformation based on the analysis. The aim is to present *technoformation* as the key concept which explains technological

mediation at the sociocultural level and a construct to be considered in explaining how societies and groups of similar culture experience technical artifacts.

3.4 ETHICS AND LIMITATIONS

In recognition of the ethical implications that this kind of research may have both on the researcher and the research participants, I took steps to fulfill basic ethical requirements regarding informed consent, privacy and confidentiality. First, I obtained an official approval from the concerned organizations prior to commencing the empirical work. This legitimized my request for official reports necessary for the research and also indulge the participants to engage with me. Second, I adequately informed each participant about the objectives of the research and use of data and results mainly for academic purposes. In addition, each interviewee formally signed a consent form as attestation of informed consent. This document has been approved by the Ethics Committee of the University of Twente.

3.5 CONCLUSION

In this chapter, I presented details about the measures and techniques I adopted in dealing with people during the research process. In addition, I provided explanation to the advantage of each step taken and the rationale for which I deemed it right. It is worth noting that it is also in this chapter that I demonstrate how the empirical part of this research aligns with the theoretical part. The next chapters contain analysis, discussion, summary and conclusion of the research.

CHAPTER 4

ANALYSIS AND DISCUSSION

HUMAN-TECHNOLOGY RELATIONSHIPS IN SANGUL

4.0 INTRODUCTION

Studying specific cases of technology is regarded as the “bread and butter” in science and technology studies (Sismondo (2011, p. viii). This is because case studies and analyses one of the effective ways by which we can get a better understanding of technology. In the previous chapters, I explored literature on the concept of technological mediation and related postphenomenological perspectives on technology. I also indicated some problems which have not been (adequately) addressed by these existing approaches especially on the subject of technological mediation in sociocultural contexts. The subsequent theoretical framework I formulated on technological mediation coupled with the methods and techniques I adopted in conducting an empirical study of the Mechanized Water System in Sangul is designed to respond to this limitation as well as provide further insight into technologies that exist in sociocultural settings.

This current chapter differs in its analytic focus on the Mechanized Water System and its mediations in Sangul. It has two basic sections: the first section comprises a discussion of the relations between the Mechanized Water System and the people of Sangul with a descriptive orientation, whilst the second section engages in a critical discussion of the experiences of the Mechanized Water System with a deep analytical

focus founded on technological mediation and related postphenomenological concepts.

4.1 MAJOR STAKEHOLDERS INVOLVED WITH THE MWS

The immediate impression one gets about the Mechanized Water System is that it is not an isolated artifact, neither by physical location nor by involvement in social affairs. The technology is deeply embedded in the spatial and social landscape of Sangul as well as the activities of private and public institutions who constitute the three basic categories of stakeholders involved in the affairs of the technology: the local community, private Non-Government Organization, and Local Government Agency.

4.1.1 THE LOCAL COMMUNITY

The people of Sangul are regarded as the primary stakeholders of the Mechanized Water System because they are the direct beneficiaries of the water supplied by the water system. The community's need for potable water was the main reason which made them eligible beneficiaries of the technology as part of a development intervention managed by the NGO (WVG Saboba ADP, 2013). Whilst the community, in its entirety, is regarded as a single actor in the affairs of the water system, its internal structures and arrangement are far from being an unsophisticated group of people living in one community. Internally, there is an established and lasting traditional governance and leadership system consisting of, mainly, the community elder (known as the *Uninkpel*), and the landlord (known as the *Utindaan*). These two traditional

leaders are the main figureheads of traditional leadership in the community and are equally involved as local authorities in the affairs of the technology.

Further explanation of the roles they play in the affairs of the technology is explained below under the section “Governance and Leadership in Sangul”. In addition to the traditional leadership, there are ‘non-traditional’ leaders who come in the form of members of committees and other community-based organizations (CBOs). In the context of the Mechanized Water System, the main locally constituted body is the Waters Sanitation and Hygiene WASH) Committee. It was established since the installation of the water system in 2011 “to ensure sustainability and continuity of service delivery” (Saboba WASH Report, December, 2011). The co-optation of the WASH Committee involves members of the community who, in a democratic fashion, collectively appoint and approve persons to occupy the roles in the committee. It should be emphasized that the design and structure of the committee is the brainchild of the NGO who also facilitate the process of establishing it. The committee is entrusted with the responsibility of caring the continue functioning of the technology. Its positions include the Chairperson, Treasurer, Pump Maintenance Volunteers (PMVs), Hygiene Inspectors (HPs) and a Secretary.

4.1.2 The NGO – World Vision, Saboba

World Vision Ghana, Saboba Area Development Programme (WVG, Saboba ADP) is the main Non-Governmental Organization involved in the affairs of the Mechanized Water System. In the Saboba District in general and Sangul in particular, World Vision is an incredibly popular organization. Since its inception in 2003, it has implemented

a wide range of social, economic and infrastructural projects aimed at improving the socioeconomic wellbeing of children and their families in the district. The organization operates "a 24-year Transformational Development program" (WVG Saboba ADP, 2013) and the implementation of the Mechanized Water System is one of the initiatives in this development programme. The NGO is a child-focused organization, and its programme goal is "to improve the socio-economic wellbeing of the people of Saboba District, with special focus on children, through the empowerment of their families and communities, and engaging the children as agents of change" (ibid).

The organization's activities are well-programmed, strategic and follow an approach known as the "development approach" (Brennan, 2013). Their intervention programmes do not come isolated but rather in an integrated fashion that cuts across different thematic areas such as health, education, and livelihood. The organization has adopted innovative approaches which inform their strategies for implementing their development interventions.

Two of the approaches which are relevant in the case of the Mechanized Water System are the Citizen Voice of Action (CVA)[2] model, and Community-Led Total Sanitation (CLTS)[3] approach. These approaches are founded on the organization's concern for sustainable development interventions. For example, the CVA model is based on the philosophy that building the capacities of the community to manage their own resources is more sustainable as compared with leaving the management of the

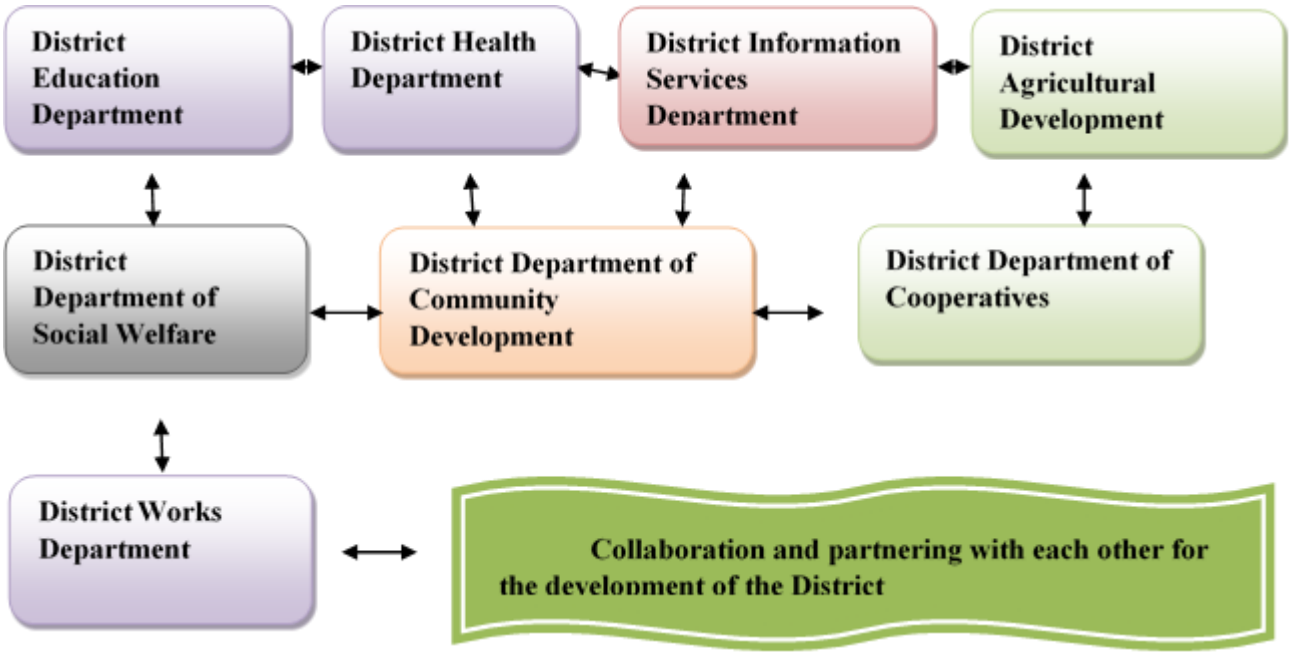
[2] Web Article: http://www.wvi.org/article/citizen-voice-and-action
[3] Main Website: http://www.communityledtotalsanitation.org/page/clts-approach

infrastructure to external bodies or institutions. Hence, there is an intentional effort by the development professionals in placing the community members at the forefront of the projects such as the Mechanized Water System so that they can take ownership of the water system and acquire the necessary skills which will ensure its continuous functioning. Similarly, the CLTS model indulges the community members to take responsibility for the cleanliness of their own community. As a result, much of the NGO's activities involve education, training and capacity development programmes. In setting up the management framework for the Mechanized Water System, the NGO involved the WASH Committee, the District Assembly, and a private company specializing in the installation and maintenance of solar-powered water systems. It is this established partnership framework which ties all of the stakeholders together with Mechanized Water System, as explained further in the section on "Relationship by use and Non-use".

4.1.3 LOCAL GOVERNMENT AGENCY – DISTRICT WORKS DEPARTMENT

The District Works Department (DWD) is one of the local government agencies in the Saboba District and is the one public agency most actively engaged in the implementation and management activities of the Mechanized Water System and many other projects (being) implemented by the NGO in the district. The DWD is led by the District Director of Works who also holds membership position in the District Monitoring Team. The agency is one of the decentralised department in the Saboba District Assembly (SDA) (See figure below for graph of Decentralized Departments in the district).

Figure 2: Saboba District Decentralized Departments



Source: Saboba District Medium Term Plan 2013 (p. 17)

In principle, the SDA is the main overseer of all development projects implemented within the jurisdiction of the Saboba District and are constitutionally enjoined to oversee all development projects in the district[4]. This puts the Mechanized Water System directly under the auspices of the District Works Department (DWD). Both local community and the NGO recognize this role of the DWD and therefore involve them in affairs relating to the Mechanized Water System. For example, the NGO delegated the task of identifying and prioritizing communities in need of water. The DWD in their effort to ensure that the water system is provided to communities which really need it further instituted a "demand-driven" approach which requires communities to proactively express interest in the water system and meet some basic requirements before they are provided the technology. For example, the people of

[4] Ghana Local Government Act, 1993 (Act 462): http://faolex.fao.org/docs/pdf/gha91927.pdf

Sangul, led by the community leaders and advocates, submitted a formal application for the Mechanized Water System, created a community-held bank account, raised an amount of GHC500.00 (equivalent to approximately £120.00 at current rates) through household levies as initial deposit. Again, this demand-driven approach is regarded as a mechanism for dispelling any assumptions among beneficiaries that the technology is "free", instead, it is meant to instil in them, a sense of responsibility, and ownership.

4.2 RELATIONSHIP BY USE AND NON-USE

By virtue of the multi-stakeholder involvement in the affairs of the technology, different relationships have emerged in the context of the Mechanized Water System which I hereby group into use and non-use relationships. According to Verbeek, there are "different relations human beings can have with different kinds of technologies" (Verbeek 2005, p. 121-122) and one way of accounting for the relations of technology is to examine people's experience of that technology (McCarthy & Wright, 2004). Furthermore, depending on the perspective that one takes (such as instrumental or mediation), it is possible to draw different conclusions about the role of technology in different aspects of human life. However, in this part, I limit discussion of the role of the technology to a cluster of factors which I formulated based on the outcomes of my discussions with the people involved with the Mechanized Water System in Sangul.

The people of Sangul relate with the Mechanized Water System in various respects. A basic criterion for differentiating the various forms of relations between the people in the community is the distinction between "relation by use" and "relation by non-use".

The rationale for these categories are explained further below, followed by a discussion on a unified set of relations which involve both users and non-users of the Mechanized Water System.

The relationship by use and nonuse includes the participation of the people in the community who patronize the function of the technology and other actors outside of the community who partake in the affairs of the technology. This can be understood within the framework of the three categories – *end-users, lay end-users, and implicated actors* – identified in (Oudshoorn & Pinch, 2008, p. 546). According to the information from the interviews, the technology is primarily used by the inhabitants of the community who constitute the end-users of the technology and the basic unit of end-users in the community are the households in the community. This means that the individual person in the community can access the system through their household subscription. This notwithstanding, individuals who dwell in the community without an affiliation to a particular household can also access the water system on their own. This means that membership of a household is an automatic access point for people to access the water system.

In addition to the household as the primary access point, there is also a user-technology relation originating from the institutions that exist in the community – specifically the community school and health post – who can be regarded as the lay end-users. Together, the end-users and lay end-users have a “relation by use” with the water system. However, accessing the water supply function of the Mechanized Water System is not the only channel by which one can relate with it. There are also

non-users who do not patronize the functions of the system (water supply) but do relate with it in other forms – constituting the implicated users. This type of relation exists between external persons who do not dwell in the community, including those who dwell in the community but do not use the water system for accessing water. Thus, the *relations by non-use* exist between the implicated users and the water system.

4.3 THE HUMAN-ARTIFACT RELATIONSHIP

The Mechanized Water System is a real tangible and material artifact stationed within the space of the Sangul community. This alone makes the technology an identifiable object which the people in Sanguli well-recognize its physical presence and material element. According to the Head of the District Water Sanitation Team (DWST) of the Saboba District Assembly, the Mechanized Water System…

> "…is a limited rural mechanization which is composed of a pump station comprising a pump fitted into the borehole, powered by a solar system, connected to overhead "poly tanks" which are raised at vantage points, and extended to standpipes."

The technology is provided by World Vision Ghana, a non-governmental organization which operates in rural districts in Ghana. The organization's water team is called the Ghana Rural Water Project (GRWP). Their main task is to install water pumps to communities that lack access to potable water.

The Mechanized Water System is different from the other hand pumps because it has a machine which is powered by solar energy. This is a purely mechanized system and consists of four main components: the borehole, the pumping system, solar energy system and the storage and distributing system. The borehole is drilled deep into the

ground to reach the water table below and a pipe inserted in the drilled hole to connect the underground water with the pump on the surface. The pump is installed between pipes from the underground well and pipes leading to the storage tanks. This way, it pulls water from below into the tanks when started. The pump relies on solar generated power and therefore is connected to a solar energy system consisting of solar panels and batteries. The machine draws water from underground and stores it in water storage tanks. The storage tanks relay water to outlets stationed at vantage points in the community for locals to collect water.

For further clarity, the diagram in the Appendix 1 shows the technical layout, and pictures in Appendix 2 illustrate the water system. It can be seen that the system is located within the residential environs of the community and visible. To further elaborate on the systems functioning and forms of relation with people in the community, here is an extract from my interview with World Vision Saboba's Programme Manager:

> "Because electricity in the community is not always reliable, especially in our part of the world, the solar mechanized system helps in this situation. It is basically to aid the community from waiting for electricity to power the system, to reduce the burden of even getting a generator or the national grid to be able to power it. So, when you go to Sangul for instance, we have two tanks in the community because we have a good yield from that particular borehole. With the overhead tanks, we store the water so that accessibility becomes easier. The system basically provides easy access to the people without the hustle of going to the pumps, walking so many miles, or having to pump manually for water. Instead, within the twinkle of an eye, you can have water by just turning the machine on or off. Switching it on will basically trigger the system to pump out water from the ground into the storage tanks and get it to the various distribution points."

It is clear from these responses that the Mechanized Water System consists of different technical parts which are interconnected, distributed across the landscape of the community, and function primarily in supplying water to people. However, the question of neutrality of the water system in social phenomenon within the community was put to interviewees to which they responded in the negative. The Head of the DWST words were “I don’t see it as neutral as such, but it is something that is playing an active role”.

For example, the system is very “technical” and requires a set of measures to keep it working. This set of measures are not merely issues of technical designer but a combination of technical design and what we can conveniently refer to as “social design”. The Mechanized Water System’s ability to keep working partly depends on establishing a form of social consciousness and institutionalizing new structures. The Manager of World Vision explained:

> Because it [Mechanized Water System] is very technical, in every community that we go to, we have what we call the PMVs who are trained and are given very basic knowledge on the pumps. When we train them, we give them manuals to be able to respond to issues on the borehole in case there is a problem such as how they can maintain it, the number of months within which they need to service the whole system. That is very easy and we train the community members to do that. We set up a water committee in the community and give them very basic understanding on how the machine works, then they select individuals to be trained to handle the system. But when there is a problem which is beyond the local level, we connect them to other members in the value chain. We link them up to a specialized company or organization that basically works on mechanized systems. This is because, even as we provide those systems to the communities, our capacity at the World Vision Area Development Program level is not technical enough to service the machines.

The Mechanized Water System does not exist or function on its own, it is part of a value chain which involves a lot other institutions and people. For this, the Mechanized Water System (Sangul) is a typical “sociotechnical system” (Wiebe E. Bijker & Law, 1992) combining both a human-composed social structure and an artifact-composed technological structure.

The relationship between the Mechanized Water System and the people transcends the basic binary relation of “water provision” by the technology and “water access” by the people. There is more that can be said about what happens “in-between” (Van Den Eede, 2011; Verbeek, 2009a). In-between the technology and human beings in Sangul are mediations of different aspects of human experience and social reality. Following the interviews with the people I identified and adopted the aspects of their experience and social reality which reveals much about how the water system meets phenomena in the Sangul society. Further, these aspects represent the “neoma” in the technological mediation process. Thus, these aspects of social life are the main points of contact between the mechanized water system and the people of Sangul and it is by examining these areas of the lives of the people of Sanguli that we can arrive at a unified understanding of what the mediations of the water system.

4.4 HEALTH AND WELLBEING

Prior to its installation, the people of Sanguli mainly relied on water from rivers, streams, ponds and shallow wells which posed a number of challenges. In total, there are two streams in the community (WVG Saboba ADP, 2011).The supply from these

sources was irregular and unreliable since most wells dried up in the dry seasons. The water obtained from them was also unwholesome and contaminated which exposed the people to diseases such as cholera/diarrhoea, bilharzia, guinea worm and other waterborne diseases. Also, mainly women and girls had to walk long distances to fetch water from these open sources which was a major constraint and significantly affected their wellbeing. The onset of this technology brought about a reduction in some of these problems and reorganized the way in which water is obtained for domestic use in the area. According to World Vision's 2013 Evaluation Report, "household access to potable water recorded a tremendous increase of 55.23%" in their entire project area of which Sangul is part.

The information from interviews with all participants also testify that the implementation and subsequent use of the Mechanized Water System coincided with the eradication of guinea worm and reduction in the occurrence of other water-borne diseases such as cholera. The technology provided a clean alternative to the contaminated water from open sources which the people depended on prior to the implementation of the water system.

Apart from replacing unclean water with clean water for the people, the flow of clean water from the system to the primary healthcare post in the community helped to provide water for primary healthcare administration as well as retain the medical staff in the community.

Furthermore, among the conditions set by the NGO which provided the water system was the need to maintain community sanitation and hygiene practices. This involved

strengthening good sanitation practices which already existed, changing bad practices through education and introducing new ones. For example, open drains were replaced with closed ones, education against open defecation was supported with the provision of household latrines, among others. I interviewed the "Uninkpel" (which translates into *Elder*) of the community and this is what he had to say regarding their experience of the technology:

> "Water issues were of great distress to us and we went around looking for solutions which led us to World Vision, Saboba and the District Assembly. They agreed to help us with the system. So we went to the *Utindaan* and asked for permission and land. Then the pump was provided which pleased us very much. I think what makes me very happy about the system is that, some time ago, we used to drink water from the river at which time we had a lot of guinea worm disease affecting people especially in the dry season. Since we had the system until now, I don't think there has been any case of guinea worm in the community. That's how I got in touch with the system. I have lived in Sanguli all my life as well." – Uninkpel

An outcome of these practices was the reduction in diseases leading to other related impacts such as increase in good health, more productive time, reduction in healthcare expenditure, reduction in mortality rates and increase in happiness. This meant that the both physical or physiological and psychological wellbeing of the people improved with the presence of the water system. The WASH Committee Chairman pointed out in the interview:

> "You know, if you fall sick today, you won't be active enough to be able to do anything to make money. If you eat good food, you develop good ideas. Because the water is clean and we take good care of it all the time, it gives us clean brains. We have seen that, now when children are born, they grow up intelligent unlike before. This is because of the clean water and clean food. And also now, we are happy and exchange felicitations in the community." - WASH Committee Chairman, Sangul

The association of clean water from the technology is not only with good health but also “clean brains”. This interpretation of the water system’s role in the community touches a subject of human intelligence. How can we relate “clean water” with “clean brains” as mentioned by the community member? As he indicates, the evidence lies in the growing intelligence of children in the community which does not imply cause-effect relationship between the technology and human intelligence enableld by changes in health and wellbeing.

4.5 ROLES, INTERACTIONS AND RELATIONS.

The roles that people occupy in society can be referred to as “organized set of socially expected patterns of behaviour” (Ogburn & Nimkoff, 1964, p. 202) and roles are said to be associated with the status that people occupy in society. In his book *“The Study of Man: An Introduction”*, Ralph Linton (Linton, 1936) distinguished between ascribed status and achieved status as two ways by which people attain their positions in society. The mechanized water system has an impact on the dynamics of roles and status as well as the general social interactions and exchanges among the people in Sangul. A number of changes have occurred in how roles are performed and interactions take place in the community. One of them is the changing roles of males and females in the community. According to the Uninkpel:

> “It [Mechanized Water System] has helped women a lot especially relieving them of going long distances to get water for use. Previously, whenever they returned from collecting firewood (or the farm), they had to go far to get water, but now, when they return they can quickly go to the pump and get water. Now, livestock owners can also get water for their animals and we do not struggle with access to water. Also, when men are going to farm and see that their women are busy, they just branch off to the pump and fill up their gallons and continue to their farms. We

> no longer have to worry that our wives may fail to bring us water and no longer request that they to bring us water from home. Now, the distances are reduced and we no longer make it the sole responsibility of women to fetch water. We both fetch. If a man's wife is not at home, he can go fetch water himself so that he and his children can cook. We no longer see it as a God-given responsibility of women to fetch water." – Uninkpel

From the words of Uninkpel, we can decipher a fading demarcation between male and female roles in the community afforded by the technology. The responsibility of collecting water for domestic use was erstwhile strictly reserved for women whilst men had little obligation towards making water available at home for domestic use or at the farm where they stay long hours in the day. Also pronounce is the apparent re-negotiation of male and female status in the household. Again, I quote Uninkpel who says the following:

> "As we exist today, if a woman does not have the money to pay for the water bills, it is the man who will get money and pay for it. She also pays when she has. Whenever the time comes to pay, it is the man who pays up and if the man does not have the money, it is the woman to pays. We both pay when we have the money.

It is clear that the people of Sangul have moved on to appreciate and accept their new state of happiness and wellbeing. That stark differentiation in male and female roles are changing in the community and how they act reflects in the relations between the genders in the community. Women now spend more time interacting with their families and men now appreciate the role of women as capable of holding leadership positions, sometimes surpassing men. For example, the position of treasure (which is considered a position of trust) is almost a reserve for women and not men. It is no longer taken-for-granted which roles are the reserve of males and females and there is an increase in role achievement instead of ascription. However, the renegotiation of role has not

withdrawn from men their role as primarily responsible for domestic affairs. In a rather rhetoric fashion, Uninkpel again expressed this in his words:

> "You know, when my wife goes to fetch water from the water pump and is asked to pay up before she fetches, when she returns home whom do you think she will confront? It is me that she would blame. Women do not care too much about who pays because they will do so willingly, it is only when they cannot afford it themselves that they put pressure on the men to pay up." – Uninkpel

Apart from gender relations, the presence of the technology has increased leisure time and facilitated intra- and inter- community interaction. The women interviewed particularly pointed to an increase in the amount of time they spend bonding with their family which was not the case when they had to spend more time trekking long distances for water. Without the need to travel long distances to get water, time is conserved providing more opportunity to stay within the community and interact with family and friends. Nonetheless, there is also the case of rising individualism because women no longer need to go for water in groups, instead, each can at any point in time go and get water from the water pump to their home without need of companionship.

Furthermore, there is an increase in exchange amongst people in the community as a result of co-participation in the technology affairs as well as increased harmony in relations with neighbouring communities. According to the WASH Chairman:

> "Before the system arrived, we already had a very communal and collective attitude in our relations. We accepted one another's misfortunes and supported one another in times of disease, death or any kind of misfortune. If one person in Sanguli had a problem, the whole village of Sangul could take the problem up. Also, our leaders have a role in resolving or assisting people who have problems in the community, it isn't the system that made this possible, it already existed. What I wish for now is that God continues to provide more water

> for this system to remain sustainable, so it can stay longer for our children and grandchildren to benefit from it" – Chairman of WAS Committee, Sangul

The demographic dynamics have also transitioned. The community and forms of interaction within it has not been the same since this distinction became eminent. Also, the scope of community interactions and relations have widened and stretched beyond the confines of the Sangul community. In what resembles the emergence of a "regional power", Sangul now has reputation of a *quasi-urban* community.

> "There are students from surrounding villages who now live in the community and they all use water from the system, they cannot drink from the river, that's one of the reasons. They are in the JHS and live here. Because we now have the water system, students move into our village to study, if we didn't have it, they wouldn't have come here." – Uninkpel

The process by which changes in the practices occur among the people of Sangul following the introduction of the water system can be compared with to what Verbeek has shown about how the microwave, a simple household technology, can change the habits in a household, affect family relations and what it means to cook or eat, or how the obstetric ultrasound machine mediates how parents conceptualize pregnancy and childbirth and further leads to the development of morality towards the unborn child. The fact that these transactions are almost in the background points to the possibility of a weak program of technological mediation. Thus, the role of the Mechanized Water System is comparable to "the way technological artifacts co-shape human action and perception, e.g., cars co-shape the perception of distance, cell phones co-shape ways of socializing, and the microwave co-shapes eating habits and family life" (Waelbers, 2007, p. 275).

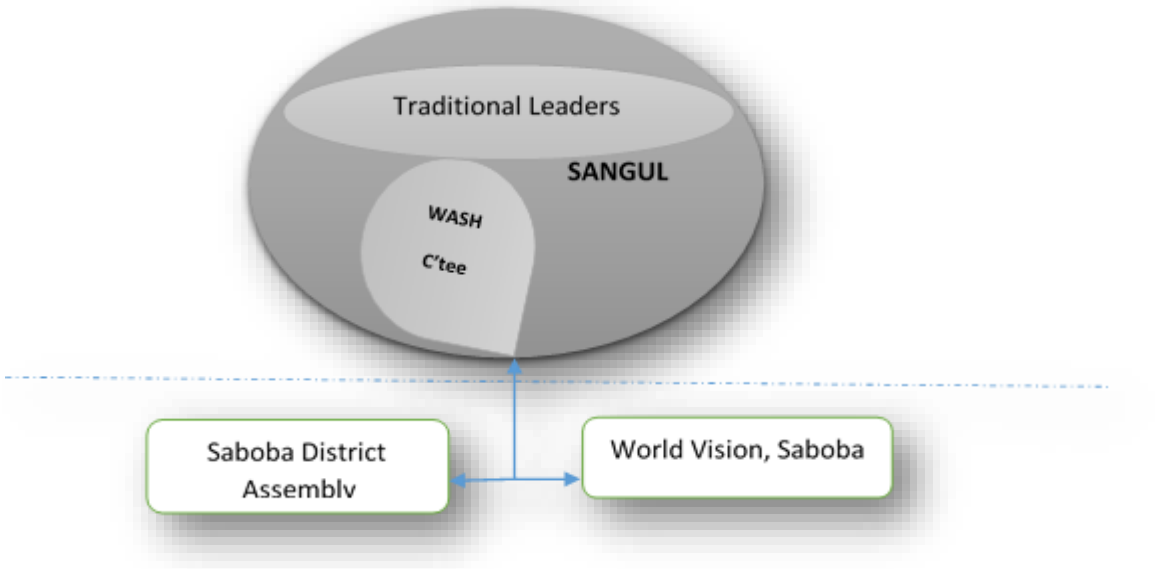
4.6 GOVERNANCE AND LEADERSHIP IN SANGUL

Traditional Governance is a common practice in Ghana. Mainly, traditional authorities embody cultural heritage and assist the constitutional government in the implementation of projects as well as ensuring peace and security and Sangul runs such a traditional leadership (Saboba District Assembly, 2006). As mentioned earlier, the Sangul community mainly have the *Utindaan*, and the *Uninkpel.* The influence of these traditional powers on issues regarding technology is not entirely new in science and technology studies as some anthropologists have already pointed out their roles in their studies.

In “Zimbabwe Bush Pump: Mechanics of a Fluid Technology” de Laet and Mol (2000, pp. 255-263) sought to show how “fluid” and intricate relations that exist between technology and society with the aim to define what “appropriate technology” is (de Laet & Mol, 2000, p. 225). In their piece, they allude to the importance of the “*nganga*” who signifies community participation in the installation process of the water pump and without whom the boring of water pumps turn problematic and resulting in them becoming, literarily, “dead” (de Laet & Mol, 2000, p. 234). Other scholars have suggested that culture could be the “antithesis of the material rationality” (Bray, 1998, p. 12) which could result in the failed adoption of technology by society. However, the governance and leadership situation in the context of the Mechanized Water System leaves much to be desired about the suggested linkages between indigenous cultural governance frameworks and the functioning of technology.

In Sangul, World Vision is the main organization involved in the implementation of the Mechanized Water System, however, they carry out the implementation of their development programmes in partnership with other agencies (governmental and non-governmental) as well as private companies and local community-based organizations (CBOs). To a greater extent, each of these organizations have unique and identifiable roles, however, carrying out the roles takes place in a coordinated fashion involving all stakeholders. The diagram below illustrates the relationship among the stakeholders in the affairs of the Mechanized Water System.

Figure 3: Major Stakeholders of the Mechanized Water System



Source: Mpuan (2015).

The main governing body of the Mechanized Water System is the Water, Sanitation and Hygiene (Facilitator) Committee. The WASH committee is co-opted and approved by the committee based on unanimity. They represent the community in engaging with the external institutions involved in the technology. However, the traditional leadership encapsulated in the “Uninkpel” (which translates into *Elder*) holds the most power and influence in the community. According to the Chairman of the WASH committee,

another of their roles is setting tariffs for users connect the community members and the system:

> "Another relationship between the people and the system is that we have set some rules that require people who come to collect the water to make some financial payments or contributions which we save to be used for repairs in case of damages. Our neighbours are not hesitant in this vein and do send their contributions to us. We regularly monitor the system." – Chairman

Moreover, the WASH committee members are the liaison between the community and external organizations involved in the water system. Within the community itself, The WASH committee explained the traditional governance structure in the community in this rather long quote:

> "In our traditional governance structure, we have the Ubor (chief), the Utindaan (landlord) and Uninkpel (leader), then there is the assembly man (local government representative). During the period of intervention, we were regularly assembled by WV and educated on how to behave in order to promote wellbeing in the community, how to deal with others from outside the community and how to function in leadership positions when we are placed in them, the patience and attentiveness it demands. This was especially beneficial to the elders in the community who had bad attitudes and also for others. Even now when you meet a child in the village they are able to communicate with you in a mature and appropriate manner to your surprise. People now interact very well resulting from the system. It has brought growth to the community and given the leaders some more wisdom into community leadership. Also, people selected into water management positions have gained added knowledge. When we did not yet have the system, our relations were cordial but it was not as strong as it is now. People now listen to one another and the leaders of each group now show respect towards one another. Now, it is even much easier to gather people together for meetings. Previously, when there were calls for such meetings, people simply said they were going to get water and left to the river. In the surrounding villages, cordiality and community participation is different because they hardly agree on opinions." - Chairman

4.7 CUSTOMS AND RELIGION

The people of Sangul remain relatively traditional in their opinion and beliefs about the world, although they are diverse in religion. This is reflected in their use of local indigenous knowledge which World Vision has adapted as early warning signs in their strategy for preparedness against disaster in the community. Without further ado, the table below summarizes some of the customary practices in the community and how they influence the people's view of the world around them.

Figure 4: Common Beliefs in Sangul Adopted as EWS

SIGN	PROBABLE MEANING	PERIOD	DURATION	DEGREE OF ACCURACY
Meeting chameleon towards you on your way to any place	There will be a family death in the family	Within a week	Any time of the year	100%
Dew which makes it difficult to see	There will be rain	Within the day	July to October	100%
Palmora palm (libokpa)fruits dropping on the ground	Any seed planted will give good yield. There will be rain	Within the rainy season	May to October	90%
When cloud form and goats are running with the young ones	There will be rain	Within the rainy season	May to October	85%
When clouds form and goats are not running	There not be rain	Within the rainy season	May to July to October	85%

Source: Sanguli Profile (World Vision, Saboba ADP).

Apart from the beliefs mentioned above, two common areas which reflect the customary beliefs and practices of the people of Sangul (similar to other Ghanaian societies) are marriage and funerals. In fact, marriage and funerals are regarded as traditional institutions central to understanding the sociology of many Ghanaian people (Nukunya, 2003). These two are the basic institutions representing birth and death and are constituted by both beliefs and actual practices that grace marriage and funeral ceremonies. It emerged from the interviews that it has become easier for men in Sangul to have their marriage proposals accepted by women from other

communities. The interviewees linked this observation to the the fact that women prefer to get married into communities where access to water is guaranteed so that obtaining water for domestic use becomes easier. What this means is that access to water is now an added factor in the list of items that women consider when choosing their spouses. It also explains the possibility of a change in the demographics of the community as more women are likely to live there and men likely to start families early.

4.8 EDUCATION

Education refers to school attendance and activities related to teaching and learning in Sangul. The community runs a Primary and Junior High School which provides basic and intermediate education for children in the community. Child enrolment, punctuality and teacher retention have increased, according to the Chairman:

> The system has been most important to our teachers in terms of education. Previously, when teachers were posted into our community to come and teach in our schools, they refused to do so, but since we had the water the teachers now accept to live in the community. As a result, there is now a cordial relationship between the teachers and members of the community. Also, school children did not prefer to live in our community, but at the moment, our schools are filled with school children. I think our schools have one of the highest student numbers as a result of the availability of water. Since the arrival of the system, teachers now live in the community and even do not leave during holidays. They stay here and teach the students. Also, before the system, students from neighbouring communities used to go past Sanguli to attend school in the district capital (World Vision Ghana), but now, the remain in Sanguli. This is because, students can now have easy access to water in Sanguli to prepare for school, and there are no huddles anymore.

Sangul has one six-unit classroom block for primary school children, a three-unit classroom block for junior high school children and two Day Nurseries for children (WVG Saboba ADP, 2011). Information obtained from the interviews indicate that the

increase in school enrolment and retention is self-evident as the classrooms are now filled with children from Sangul as well as neighbouring communities. This was interpreted as an effect of the availability of water in the community which means that school children need not go long distances to get water before making their way to school. As a result, punctuality is high among school children. Further, teachers (who are usually transferred from other parts of the country to the community) now accept to live and tech in the community because access to clean water is a guarantee for them. In general, the community has also undergone a series of education and trainings which emphasize the importance of education and the need to keep their children in school. Collectively, these factors have brought about a rise in the value of education as well as a culture of curiosity and desire for more knowledge in the community.

4.9 DISCUSSION

The Mechanized Water System comes as part of an effort to improve the lives of people in Sangul. This suggests human intentionality and implies that the water system itself is designed and installed with the aim of achieving this specified goal. However, it is understood however that the path to development is not a “one-way” path, hence, the integrated approach adopted by World Vision in implementing the technology and the networked nature of the conditions surrounding the mechanized water system means that ascribing agency to the outcomes of development in the community will not only take into account the impact of the water system but also the

role of accompanying intervention programmes such as hygiene education, management training among others.

According to (Kiran & Verbeek, 2010), “trust is a central dimension in the relation between human beings and technologies” (p409) and the relations between the people of Sangul and the Mechanized Water System prompts us to ask whether the people trust the water system? From one point of view, the people of Sangul are very pleased with the technology and its impact in the community and attribute some of the positive changes in the community to it, however, the question of trust in the technology is one which attracts varied opinions. The Mechanized Water System offers the people of Sangul access to clean water which they did not have prior to its installation, what has been referred to as affordances (Gibson, Reed, & Jones, 1982). In this respect, the technology has enabled the people of Sangul to access clean water and can hardly be regarded as a great danger to the community. Also, many practices in the community have developed new forms and the people now act and think differently in some respects as identified above. This partly portrays the view that people can perceive the world differently as an impact of technology and that we can use technology to some predefined goals (Kiran & Verbeek, 2010).

It is also understandable that apart from giving access to clean water, there are other possibilities that the technology has opened up for the community. Hence, the role of the technology in the how social practices and perceptions within the community cannot be over-emphasized. The presence of the system has led to the creation of some new institutions and strengthening of some existing ones as part of the

integrated community development programme aimed at sustaining the water project (Gardner & Lewis, 1996, p. xiii).

Furthermore, the technology does not only exist as a tool for access to water, the community and other stakeholders behold of the technology as a commodity and resource which they have to protect and maintain. As a result, there is a supply chain in which different actors function to keep the technology working. The introduction of a tariff system for all users of the technology itself signifies how much commodified the water system has become.

Moreover, the water system does not only have a one-directional relationship with the community, it is in fact mutual bi-directional relationship. For example, the water systems ability to continuously function is not borne out of its own independent technical functions but also dependent on the success of social processes such as fund raising. On the other hand, the people of Sangul require the technology to function so that they can continue to have access to clean water. Therefore, both technology and society co-constitute each other in a process where one requires the other to properly function. This means that the modernization process of the Sangul community does not depend solely on the presence of the technical artifact but includes the social processes which are kicked into action such as mediation of gender relations, governance and leadership, education, health and hygiene among others.

This kind of co-constitution of human beings and technology deviates from the instrumental view of technology as mainly a tool used to achieve an aim, rather, technology is capable of “aids our intentionality” (Kiran & Verbeek, 2010). For

example, the water system has properties of a tool for accessing clean water as well as function of an entity which shapes social processes and in turn is shaped by them and it is this kind of exchange between humans and technology which highlights technological mediation in Sangul.

It can also be argued that the experiences of the people of Sangul of the impacts of the technology is not restricted to only the individual, but is largely shared by most members of the community. On the one hand, it is possible to identify different ways in which different categories of persons relate to or experience that technology in line with the concept of multistability of technology, but on the other hand, it is also possible to identify patterns which indicate the shared experiences of the technology in line with the concept of intersubjective experiences. To most of the people in Sangul, the technology is opaque because it is visible and confronts them in their daily lives (Kiran & Verbeek, 2010). Hence, whilst the water system is multistable in its mediation of experiences, it is equally steady in how people experience it.

4.10 CONCLUSION

The forgoing discussion suggests that there are not only obvious social impacts of the Mechanized Water System such as access to safe water and an improvement in health and sanitation, but also playing a part in changes in society which go beyond these obvious aspects. Sociocultural dimensions such as “behaviors, attitudes, cultural beliefs, and modes of social organization” (P. Brey, 1997, p. 71) are the main aspects that harbor the long term impacts of the technology. Most development

agencies (governmental and non-governmental) undertake “assessments” of their development interventions, in most cases, primarily to ascertain whether such interventions have successfully met the “objectives” or overall goals of the intervention.

Although, such assessments can discover both expected and unexpected outcomes, they do not weigh-in on the full impacts of the technologies involved in such interventions. Although it is common to think that technology is a “means” to attaining specific goals in social development and some “impact” is expected when technologies for development are implemented, what many a development practitioners can also begin to appreciate is the expanse of impact that these technologies have on the society that host them. As in the case of the Mechanized Water System, a water-providing technology may serve the basic purposes for which it was provided, but such a technology could also stimulate a transition in sociocultural aspects of the community which are fundamental to the perceptions of the people as well as their practices, as developed further in the next chapter.

CHAPTER 5

TECHNOFORMATION

5.0 INTRODUCTION

The interest in knowing the range of impacts that technology has is not only within the interest of scholars and researchers, but also designers and people who use it. What is incontrovertible is that we can no longer reduce the impacts of technology to only

its apparent functions and purpose – which is to say that technology can no longer be black boxed (Verbeek, 2006). In addition, our interest in the impact of technology should extend into its role in how social reality is constituted. It is by examining the role of technology in the constitution of social reality that we can satisfactorily understand the world in which we live in, the elements within it, our own selves, our perceptions and actions.

Within philosophy of technology research on the mediation approach, there is already some progress made in showing that the presence of technology affects how we perceive of phenomena in the world around us and the actions we engage (Ihde, 1990). For example, there is some explaining about how technology can transform how we perceive of the world and the moral and ethical decisions we make (Kroes & Verbeek, 2014a; Verbeek, 2009c). The discovery and use of contraceptives such as the pill has transformed our ideas about the purpose of sexual relations hitherto thought to be reserved for the purpose of procreation and access to images of unborn foetus shapes our perception of the unborn child (Verbeek, 2008c). Further, it has been shown that the material presence of domestic technologies such as the microwave, and their use mediate catering practices and arrangements which eventually re-organizes and re-shapes the relations within the family (Cockburn and Ormrod (1993).

What these examples point to is that, within the general experience of technology, the perceptions we have of the world as well as the practices we engage in undergo transformation and do take on new shapes. In the vocabulary of postphenomenology,

mediation refers to the various changes which can take place within human-technology relationships and *co-shaping* has emerged to show how the shaping of phenomena is the outcome of kneading between technology and the human being in society (Rosenberger et al., 2015; Verbeek, 2006, 2012; Verbeek & Slob, 2006). What has fallen short within postphenomenological vocabulary is a concept which explicitly points to the mediation or co-shaping of perceptions and practices. It is for this reason that I propose the concept of *technoformation* as a construct which encapsulates the mediation and co-shaping of perceptions and practices in sociocultural contexts. Technoformation, therefore comes as an addition to the family of postphenomenological concepts that explain further, the mediated experience of technology in society.

5.1 TECHNOFORMATION: RATIONALE FOR EXPANDING MEDIATION

In the previous chapters, I examined the forms of human-technology relationships in both theoretical terms and empirically as they exist in the Sangul community. What has emerged from this examination is that the experiences of the people regarding the technology are not limited to individual persons but also shared among members of the community in its entirety. This outcome entails that the spectrum of mediations of the water system in Sangul do not make a perfect fit with the types of relations identified and explained by Ihde and Verbeek. This may be because of the fundamental difference between the formulaic representations by Ihde and Verbeek which are skewed towards the perspective of individual experiences of technology

compared with the collective sociocultural experience of technology. Note that the individual-oriented typologies by Ihde and Verbeek are also recognizable by their depiction of the individual by “I” in the “I----Technology----World” relationship. However, irrespective of its cross-sectional sociocultural occurrence, the experiences of the Mechanized Water System cannot be isolated from the human beings in Sangul. Instead, one can argue that the common experiences of the technology result from a cluster of individual experiences of the people in the community. This is why subjectivity is not the sole concept of interest in explaining the experience of technology, but also intersubjectivity, which comes in handy in examining technological mediation as it occurs within the sociocultural of Sangul.

In order to avoid jumping into quick conclusions about the insufficiency of the human-technology relationships identified by Ihde and Verbeek in explaining mediations in sociocultural contexts, I will first discuss the various relationships and how they apply in the specific case of the Mechanized Water System. This provides fair ground to show the extent to which the forms of mediation relations identified by Ihde and Verbeek work out in sociocultural contexts as well as demonstrate the amount of inconsistencies that exist between these forms of relations and mediations in sociocultural contexts. Hopefully, this will also set the agenda for the exploration of technological mediations in a different light that reflects the experience of technologies in broader sociocultural contexts.

5.1.1 APPRAISING FORMS OF HUMAN-TECHNOLOGY RELATIONSHIPS

If we were to view the Mechanized Water System and its relationship with the human being from an individual perspective, it would emerge that the system is not close enough to the corporeality of the individual to be worthy of an *embodied relation*. Of course, there may be some contact with the water system, by way of turning the taps on or off, opening parts for maintenance or repair or cleaning, but such a relation is not one comparable to the human being wearing a pair of glasses and viewing the world with it.

Also, the possibility of describing the relationship between the water system and people's experience and understanding of the world in terms of a *hermeneutic relation* is limited on various grounds. In this instant, the water system is well-subjected to some form of interpretation. The system can give an indication about the amount of water underground by the amount it can produce to fill up storage tanks, or even the solar panels can tell how much sunshine is there by how much power it can produce to charge up the solar batteries. Such an interpretation can be considered a hermeneutic relation because the water system and what information it tells about the world is comparable to what the thermometer tells about temperature. Nevertheless, such a description presents some problems which questions the suitability of this situation for a hermeneutic relation as identified by Don Ihde. The problem lies in the fact that the technology is not designed to tell water levels or amount of sunshine in a day. Unlike the thermometer which is purposely designed to measure temperature and draws an intuitive understanding of the amount of temperature in addition to a

considerable amount of trust in its measurement, the same cannot be said about the water system as a measure of quantity of water underground or the amount of sunshine in a day, neither intuitively nor with trustworthiness.

The *alterity* form of relation appears to be representative of some aspects of the human-technology relation in Sangul. Specifically, going to the distribution outlets to collect water from the taps resembles what we do when we visit the ATM. However, this is just a piece of the puzzle and does not describe the nature of the relationship holistically.

The technology's very presence and occupation of space within the community testifies to its *background* function. It can be said that the presence of the technology "nudges" (Pinch, 2010) certain aspects of the community's functioning. However, it cannot be drawn conclusively that the Mechanized Water System solely remains in the background, because the system does play a role recognized as active in the phenomena that takes place in the community. That is why I explore the viability of the hermeneutic relation as the more pronounce form of relation. The implication of this hermeneutic relation is that the human-technology relation in Sangul is not techno-centric, instead, it can be argued that the mediation relation occurs within the interface of perception and praxis. In postphenomenological terms, perception and praxis cohere and are hardly separable. Below, I discuss further on perceptions and practices as interfaces of mediation in the human-technology relationship in Sangul.

Further, the *cyborg relation*, as explained in Verbeek's "cyborg intentionality" (Verbeek, 2008a) is hardly the case with the Mechanized Water System and people

in Sangul. This implies that the interface of mediation relations is not exclusively via the body of the people in the community as it would in a bionic or cyborg relation. The most that can be said of the human-technology relationships in Sangul from Ihde's forms of relations is that the water system has some function which lurks in the background.

A *composite relation* as explained by Verbeek comes close to describing the kind of relation that exist between the people and the technology. This is because double intentionality can be identified in some aspect of the relationship. There is intentionality in the technology itself as seen in its function in supplying clean water, as well as intentionality originating from the stakeholders involved in the technology as evident in their desire to have the system functioning. However, it cannot be concluded that such a relation is representative of the totality of interaction between the people and the technology because it goes beyond what the people or technology want what they eventually get as outcome of mediation and co-constitution.

The forgoing analysis of the forms of human-technology relations effectively point to its strengths as well as weaknesses when applied to a specific case of technology. In these case, the forms of relations are able to offer a framework for some explanation about the water system and its relationship with people in Sangul, however, there are obvious limitations in the extent to which it can get to the reality of the human-technology relationship in this case. But, the issue of limited explanations is not new in philosophy. According to Ihde:

> "It should be understood from the outset that the task of a philosophy, no matter how far reaching or profound, is also limited. The philosopher cannot provide formulaic answers to the questions posed, nor are there in any likelihood such simple answers. There are two things that a philosophy can do: It can provide a perspective from which to view the terrain in this case, the phenomenon of technology, or better, the phenomenon of humantechnology relations. Second, a philosophy can provide a framework or "paradigm" for understanding." - (Ihde, 1990, p. 9)

The fact that the forms of human-technology relationships in Sangul do not make a perfect fit with any of those forms of relations identified by Ihde and Verbeek does not imply their complete fallacy, instead it points to the existence of other forms of human-technology relationships beyond those identified by Ihde and Verbeek. One the one hand, a source of divergence from these forms may originate from the water system itself as a technical infrastructure which is different from the types of technical artifacts analyzed by Ihde and Verbeek in their theorizing. One the other hand, one can also argue that the fundamental difference lies in the sociocultural context within which the water system exists in Sangul. In order to explore these two possibilities, I turn to the theoretical framework and literature discussed in Chapter Two, to enquire "*what* is being mediated" (*neoma*) and "*how* does the mediation take place" (*neosis*) in the context of the mechanized water system. I begin by conceptualizing perceptions and practices as the mediated neoma through a co-shaping process which I dub technoformation.

5.2 CONCEPTUALIZING TECHNOFORMATION

In the preceding section, I stated categorically that what is being mediated in the sociocultural context of the Mechanized Water System are perceptions and practices

and how this mediation takes place is *technoformation*, but further explanation is needed to substantiate such claims. Perceptions and practices are no new terminologies in philosophy in general and philosophy of technology in particular. There has been considerable discussion on perceptions and practices by various scholars and below are a few references which explain how perceptions and practices are conceptualized.

5.2.1 PERCEPTIONS AND PRACTICES

I begin with reference to Verbeek according to whom "technologies help to shape the way in which reality is present to human beings; not only how they perceive the world, but also the frameworks in which they interpret it" (p121-122). With this extract, Verbeek connects technology with perception of the world and subsequent interpretation. Hence, not only does technology help to shape what we perceive, it also contributes frameworks within which we can interpret the world. A common framework within which humans can interpret the world is our experience of it, and the fact that technology has a role in how we interpret the world implies that our experience of technology itself can underlie our perceptions and interpretations of the world around us. Related with the framework of interpretation of technology, Don Ihde identified two perceptual dimensions: microperception and macroperception.

> "The first is the bodily dimension of sensory perception, which Ihde calls microperception. The second consists of the frameworks within which sensory perception becomes meaningful. Human experiences can be conceived as "interpreted perceptions," in which the interpretations are always informed by the cultural context in which they take place. This contextual dimension of experience Ihde calls macroperception:" – (Verbeek, 2005, p. 122)

In a more categorical fashion, perception is divided into micro and macro by Ihde where micro refers to individual sensory perception whilst macro refers to “cultural, or hermeneutic perception” (Ihde, 1990, p. 29). However, Ihde adds that “the relation between micro- and macroperception is not one of derivation; rather, it is more like that of figure-to-ground in that microperception occurs within its hermeneutic cultural context.” (Ihde, 1990, p. 29).

Taking this distinction within the principles of postphenomenology where approaches are largely “non-foundational, anti-essentialist, anti-Cartesian” (Ihde, 2009, p. 23), one can argue that this dichotomy between micro and macro can hardly be substantiated in reality. Nevertheless, it offers us the convenience of identifying characteristics which are more consistent with how individuals experience technology and shape their perceptions versus how groups or collectives do. Additionally, *macroperception* specifically points to cultural perception thereby obscuring any claim that a collective perspective of the world does not exist. This is the more reason why my conceptualization of technoformation as shaping of perceptions and practices at a sociocultural level comes in close affinity with postphenomenological thinking.

But what does building on a conceptualization of perception as extending beyond individual perceptions to explain the sociocultural experience of technology entail? First, microperception concerns the individual sensory experience of technology and Ihde elaborates microperceptual experience of technology from the view of Merleau-Ponty. As Ihde puts it:

> "Merleau-Pontean microperception is always a kinesthetic perception: My body is geared into the world when my perception presents me with a spectacle as varied and as clearly articulated as possible and when my motor intentions, as they unfold, receive the responses they expect from the world. And it is out of this sensitivity towards a body-world correlation that Merleau-Ponty anticipates a different role for technologies within the realm of perception and praxis. The lived or virtual body as an experienced bodily spatiality can be "extendible" through artifacts" (Ihde, 1990, p. 39)

The extract from Ihde above offers some detail about microperceptual experience which translates into bodily sensation manifested in how human beings interact with other objects within the environment. It especially highlights the physiology of the human being "geared into the world" as well as the "motor intensions" which respond to perceptions. Also, one can draw a number of lessons from this relation as shown in the extract beginning with the relation between perceptions and praxis (which I return to later below). Moreover, a key question to ask is how much awareness the individual develops about space and the body including its extensions. This suggest that even microperception portrays a sensation which extends beyond the immediate confines of the individual body to their environs. In essence, microperception is not only about what goes on in the head but also what is present around the person. Following from these lessons, it can be argued that microperception and macroperception, when critically examined, end up as adjutants for each other without any far-reaching characteristics to separate them. A more vivid explanation comes in this quotation from is as follows:

> "The ways in which reality comes to be meaningful for human beings depend not only on their sensory relations with it but also on the contexts in which meaning arises. One finds in Ihde's work two macroperceptual contexts in which forms of technological mediation play an especially important role: the cultural context in which everyday human life plays itself out and the scientific

> frameworks of interpretation that, to be sure, play an increasing role in everyday life" (Verbeek, 2005, p. 135).

First, this extract acknowledges that perception occurs within contexts and, second, demonstrates with examples from the work by Ihde that perceptions are not only restricted to the micro level but also the macro level. By relating perception to both individual sensory experience as well as context, these theorists also invite attention to viewing perceptions from the enactivist perspective.

According to Evan Thompson in his book *"Mind in Life: Biology Phenomenology and Sciences of the Mind" (2007)*, the enactive approach relates with the concept of enaction which was first introduced into cognitive science by Varela, Thompson, and Rosch in 1991 (Thompson, 2007, p. 13). The approach draws on subjects relating to epistemology or knowledge and leans towards the conception that the mind and body together with its interaction with the environment is what produces knowledge (Thompson, 2007; Varela, Rosch, & Thompson, 1992). Also, it is a relatively recent formulation of what perception entails and tries to overcome problems present in the traditional internalist and externalist conceptualizations and follows the argument that the perceptions that people hold of their world develop out of interaction between their mind, body and external environment. Therefore, from the enactivist point of view, perceptions within a sociocultural context may originate from the interaction between personal and environmental factors in that context including technology.

From a postphenomenological perspective, it is possible to view enactivism as overcoming the subject-object, idealism-realism, and internalist-externalist distinction

which is characteristic of the earlier conceptions of perception. As a result, it is possible to assess both internal factors and external factors that may underlie the perceptions within the sociocultural context (Stewart, Gapenne, Di Paolo, & cognitive, 2010). Second, it lays no restriction on examining the social dimension of perceptual experience. Thus, to view perceptions and practices within a sociocultural context is to hold the view that the mediations in the sociocultural context of the technology is a product of the intersection between their internal convictions and the environment in which they find themselves.

Perceptions are also interconnected with practices because perception goes with praxis in the lifeworld. Within postphenomenology, perceptions and practices have appeared together in analyses. For example, Verbeek shares the view of Ihde who distinguished between two types of mediation, one based on perception and another based on praxis (Ihde, 1990, p. 31; Verbeek, 2011, p. 8). The first type of mediation based on perception is the “experience-oriented” perspective which starts from the side of the world and directs itself at the ways reality can be interpreted and be present for people. The second perspective is the pragmatic or “praxis-oriented” mediation which approaches human-world relations from a human side with its central question being human action regarding how human beings act in the world and shape their existence.

Furthermore, it is understood that “at the cultural or societal level, the playing field of anthropologists and philosophers, issues like focal practices, societal and cultural embedding of technology, and dominant value systems all play a part” (Muis, 2006, p.

291). The interoperability between perceptions and practices helps to understand how what people think affect what they do and the vice versa. Also, it also contributes to a better understanding of how individual experience culminate in shared practices within the sociocultural context.

Therefore, technoformation is based on the premise that "artifacts transform experience" (Ihde, 1979a, p. 53; Verbeek, 2005, p. 126). Etymologically, technoformation is a neologism formed from the combination of "technology" and "formation". Technology has already being widely discussed in this study but formation is defined as "the development of something into a particular thing or shape" (Cambridge University Press, 2015). Following from the roots of the word, technoformation constitutes the role of technology in the development of something into a particular thing or shape. However, used as a term, technoformation is the construct which encapsulates the kind of technological mediation which takes place in sociocultural contexts and accounts for the co-shaping of the perceptions and practices shared in this context. To elaborate on the technoformation of perceptions and practices, I will first review some existing case studies of the role of technology to show how technoformation is inherent in those cases, then discuss how technoformation occurs in the case of the Mechanized Water System in Sangul.

5.2.2 TECHNOFORMATION: CASE OF THE MONASTERY AND THE CLOCK

Ihde regards Mumford's explanation as "probably one of the best-known expositions of a relationship between a technology and a form of life" (Ihde, p59). According to Ihde:

> "Mumford's exposition primarily related the clock to a changed social time. First, in the monastery, the clock regulates social movement, making it both more ordered and more uniform. The first clocks used in the monasteries were one-handed and told only the hours. These, in turn, regulated the hours of work and devotion of the monks. Mumford notes that this also changes our perception of time, at least in contrast with non-clock cultures. One such change is increasing quantification". " (Ihde, 1990, p. 59)

The "Monastery and The Clock" is an analysis of the impact of the machine on modern civilization. Lewis Mumford argues that the "during the first seven centuries of the machine's categories of time and space underwent an extraordinary change, and no aspect of life was left untouched by it" (Mumford, 1934, p. 12). In his analysis, he also talks of the impact of the clock on human perception of time and the emerging practices in the monastery which later transformed how people organized themselves. In his view, the clock which started as a way to keep track of "canonical hours" within the monastery had far-reaching impacts "…for the clock is not merely the means of keeping track of the hours, but of synchronizing the actions of men". (Mumford, 1934, p. 14).

The goal of Mumford's analysis primarily portrays how a technological system such as the clock transforms phenomenon in society, a process which portray the moulding of the course of life in society. When viewed in the light of technoformation, Mumford's analysis shows how the clock contributed to the transformation of ideas (or perceptions) about time and the accompanying modifications in the structure of human action (practices). Besides, the experience of the clock drew further need for more structure which affected the shaping of the clock itself leading to its very sophisticated

form in our current times. In the next section, I attempt to clarify technoformation better using examples from the case of the Mechanized Water System.

5.2.3 TECHNOFORMATION: CASE OF THE MECHANIZED WATER SYSTEM

In my study of the Mechanized Water System, the technical artifact forms part of the environment of the people of Sanguli and their experience of the technology is demonstrated in the changes in their perceptions and practices associated with the following ontologies: health and wellbeing; roles, interactions and relations, governance and leadership; custom and religion; and education. The dynamics of these listed ontologies is what demonstrates the kind of forms that perceptions and practices are enacted in Sangul and I explain technoformation in the community.

In general, the presence of the technology has brought new realities to the people of Sanguli: Besides the need to accommodate a new technical system, they also have to adapt their social system and bring up new institutions to support it. Mainly, a Water Sanitation and Hygiene (Facilitator) committee consisting of selected community people have been established to monitor the proper functioning of the system. This entails regular maintenance checks, replacement of broken parts, logging, cleaning the environs of the system and reporting to external monitoring agencies. Also, the community has the authority to collect contributions/payments from households for using water, deny defaulting households access to the water. A new form of reporting and community engagement has also emerged with the WASH committee's authority to convene meetings on issues regarding the system as well as their responsibility to manage the funds and debit/credit accounts purposely created for the system.

Another area where there are observable changes are the practices in the community which come in two ways: those practices that have dwindled or phased out and; those practices that have arisen. One of the practices that have dwindled significantly is the commute of, mainly, women and children to long distances to collect water from sources such as the river for domestic use. This was done mainly in early mornings and late evenings when women and girls headed (sometimes in groups) to these sources to collect water. Another practice that has reduced is the large scale storage of water at home. Households used to store as much water as they could over long periods of time in order to be able to use it longer. This was the case for most people who wanted to reduce how frequently they had to go to get water. In addition, saving water during rainfall is no longer a major practice. The purpose of this practice was to store rain water which was considered cleaner than water from the open sources and also saved women and children from going long distances to get water. There were also practices typical of most communities with little or no access to water such as storage mechanisms, and alternative purification methods. With regards to emerging practices, the people in the community pay levies for the water they consume on a monthly basis.

Thus, the technology does not only provide a means for the community to gain access to potable water, it also plays a role in shaping perceptions and practices in their world. These realities are evident in the structural and ideological shifts emanating from the transactions between the people and the technological system. For instance, the long distances to open sources of water entrenched the idea that collecting water was

predominantly the duty of women and children and not men, however, this gender-laden role has since lost its essence because men now go to the closer sources of water provided by the technology to get water. This is a new meaning to what collecting water entails. Furthermore, there are role conflicts. One such case is the rise of new forms of authority in the WASH committee which not opposed to traditional authority but instead complementary to their functioning and even sometimes rejuvenating the extent of their influence in community relations. Also, people are accepting that certain illnesses are linked to sources of water as a result of the experience of cleaner water and more sanitary conditions, and their less reliance on or need of natural sources of water has implications on their behavior or interpretation of their environment and other natural and social phenomena. For example, they may not appreciate heavy rainfalls as they used to because it is no more a major source of water. Additionally, there is an adjustment in the diction of the community with the introduction of new terminology which the community has to imbibe and communicate with, especially relating to hygiene and machine parts. These and many others such as the reality of conceiving a technological component of society affects how the people make meaning of the world around them.

5.2.4 TECHNOFORMATION IN THEORY AND PRACTICE

Both theory and practice have been two important dimensions in this research and formulating *technoformation* as a construct has implications for both technological theory and practice. More specifically, the concept of technoformation has implications

for the mediation approach to technology as well as the practice of *technology for development*. Below, I discuss three such implications of this concept.

Human-Technology relations are not merely instrumental

There is an "in-between" (Ihde, 2011; Van Den Eede, 2011) in human-technology relations. The Mechanized Water System is not merely a "means to an end" nor the people mere "beneficiaries" of a *technology for development*. To say the Mechanized Water System "determined" the developments in Sangul is an exaggeration, similarly, attributing "cause" of the changes occurring in the community to the water system is an overstatement. As the information shows, the Mechanized Water system is more than just a solution to the water problems in the community. There is a co-shaping relationship between the technological phenomenon and other social phenomena. This is seen in the people's role in ensuring the existence and continuous functioning of the technology, and the role of the technology in the community's ability to overcome water-borne diseases among other things. For example, the Head of the DWST sees a link between the technology management dynamics and the technical functioning (or breakdown).

> "I see a link between the management and the physical breakdown of the system because if there was proper management in place and enough funds are being mobilized as is expected, it means that irrespective of whatever technical problems come, the downtime (period of breakdown) will be quite reduced because they (community) already have the funds and will be able to address it faster." – Head of DWD

Relations are therefore far from being unidirectional, instead there is a back-and-forth, multidirectional relationship between the water system and the people. This is in

tandem with the basic assumptions of the technological mediation approach that human-technology relationships are not one-directional, deterministic or instrumental.

The Mediation relations are possible at the Sociocultural Level.

There may be some contact between the people in Sangul and the water system in the form of turning taps on an off, or even ingesting the product of the systems functioning (water), but a case of human-technology embodiment can hardly be made in this case. The people do not embody the technology as a person with a wearable device or prosthetic limb would. In effect, there is no direct corporeal relation between the people and the technology.

Intersubjectivity

Thomas Scheff defines intersubjectivity as "the sharing of subjective states by two or more individuals (Scheff, 2006, p. 41) Intersubjectivity is a moderate approach to social cognition in the debate between cognitive individualism and cognitive universalism. People do not experience technology the same way, however, they can do so in “thought communities” (Zerubavel, 2009). Here, it is suggested that the experience of technology by humans, no matter how subjective such an experience appears to be or even how fused the human is with the technology, the experience is not fully individualized but also possess the property of community (Zerubavel, 2009). Thus, technological mediation is not only subjective but also intersubjective in the sense that people within the same sociocultural setting are likely to have similar patterns of experience and response to the impacts of technology. Nevertheless, this does not suggest the superiority of social cognition or conscious over individual

cognition or consciousness, it only claims that there is a window of exchange between individual experience and collective experience based on the enactment of the individual in their environment.

5.3 SUMMARY AND CONCLUSION

This study started with objectives to analyse the relations between the Mechanized Water System and people in Sangul; Analyze the role of the Mechanized Water System in co-shaping perceptions and practices in Sangul; Get a better understanding of the mediations of the Mechanized Water system and how people in Sangul experience them, identify the implications on our understanding of the technological mediation approach in sociocultural context; and formulate an evidence-based and theory-informed framework which contributes to understanding, design and implementation of *technology for development*. Each chapter has been crafted systematically to contribute to the achievement of these objectives.

It so happened that the Mechanized Water System has had a broad and wide-ranging impact on the community transcending the expected functions of the technology. Much detail exists in the different aspects of the community which has changed, however, within this collective of changes, the main role of the technology is evident in transitions in *perceptions* and *practices* in the community. As I argued, the people's world can be conceptualized as the structure of the perceptions and practices. Thus, the role of technology in transitioning these structures implies a transition in their world (as they conceive of it and act in it). Also, my analyses of the form of relations based on existing concepts in technological mediation theory brings more insight mainly into the role of

the technology in how the perceptions and practices take shape in a sociocultural context.

As a concrete result of the study, I attempted, in the final chapter, to expatiate on the concept of *technoformation* to show how perceptions and practices take shape in a context consisting of a non-embodied technical artifact and a communal context. Building a concept in philosophy of technology is a daunting challenge, however, concepts are mainly building blocks of theory that extend, and in most situations contribute to sharpening the edges of theoretical perspectives or orientations. As elusive as the explanation of technological phenomenon is, many have made strides to provide thinking paths in explaining and understanding technology and my attempt to present and defend the concept of *technoformation* also comes in as a new window for viewing technological phenomenon in society.

5.4 FUTURE RESEARCH

Reflecting on my experience with this study, I have the conviction that examining the role of indigenous governance frameworks in technology governance and management will make a good cross-cutting subject for further study. This is because I believe that it is critically important to be aware of the actual and potential impacts of technology on society both in the short and long term and understanding indigenous governance and management frameworks and the role they play in the evolution of technology from design to implementation and beyond would positively affect how technologies are designed, implemented and managed.

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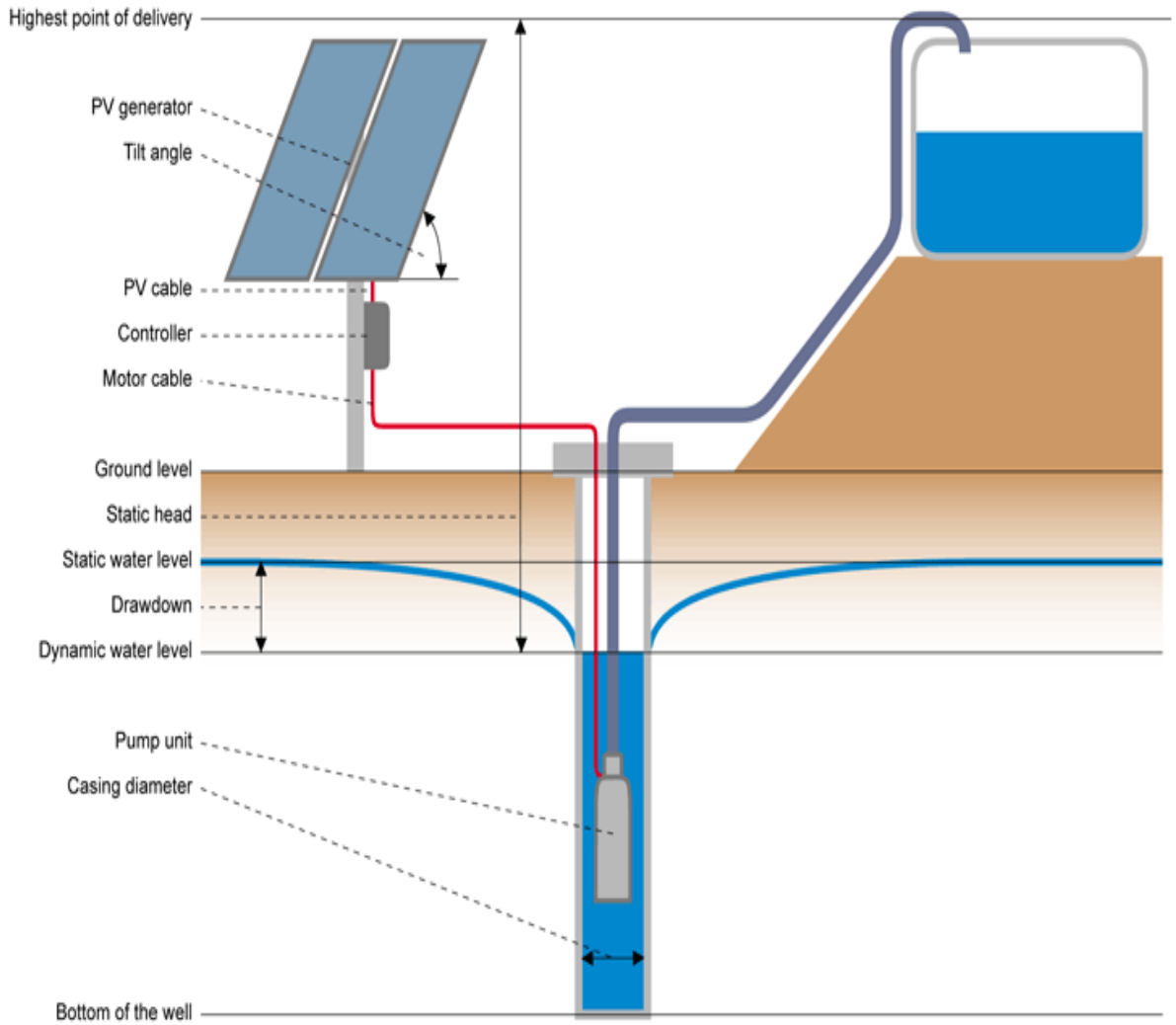
APPENDIX 1: COMPLETE LAYOUT OF THE MECHANIZED WATER SYSTEM



Source: FreshEnergy, 2015 (Retrieved from http://freshenergy.co.nz/alternative-energy/solar-water-pumping/, August 1, 2015)

APPENDIX 2: IMAGES SHOWING THE MECHANIZED WATER SYSTEM IN SANGUL

Image 1

Source: Mpuan (2015)

Image 2

Source: Mpuan (2015)

Image 3

Source: Mpuan (2015)