Challenges in implementing environmental requirements for construction of electricity infrastructure: Perspectives of non-environmental project team members

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PREFACE AND ACKNOWLEDGMENTS

All glory and honour to my Lord and Saviour Jesus Christ, without whose grace, this would not have been possible. To my husband, George Moeng, the unwavering support and sacrifices you had to make to enable me to pursue my Masters do not go unnoticed. Thank you so much my Sthandwa for going the extra mile and covering for me on various aspects so that I can pursue this goal, I am so blessed to have you. To my son, Laone, you were just a toddler and possibly oblivious to what was going on. You had to face some moments where I could not give you the attention you wanted. Thank you, my boy, for your tenacity and always being so excited to see me when I returned from long and late sessions working on my studies. You are such a champion and always encouraging me. My parents, thanks for setting the foundation for me to always aim higher and be the best I can be.

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This has been a challenging journey but here at the end of it, I'm glad I did not give up. To God be all the glory.

ABSTRACT

Access to sustainable electricity has been identified as playing a crucial role in the drive towards sustainable development. As a result, infrastructure projects are being implemented at a fast rate to improve availability and access to this energy source. The construction phase of infrastructure development projects is usually the most environmentally destructive and where mitigation of impacts is crucial. In order to guide the management of impacts that materialise during the construction phase of electricity infrastructure projects, there are various environmental requirements that need to be applied by construction stakeholders. These requirements emanate from environmental regulatory provisions, policies, best-practice guidelines and other tools that are aimed at promoting sound practices to manage activities with a high potential of negative impacts. The implementation of these requirements is often the responsibility of project team members who do not always have the expertise or competencies in environmental management. This is inclusive of engineers, project managers, construction workers and site supervisors, who can collectively be referred to as “non-environmental” project team members. This group of stakeholders often inherit environmental requirements which they are expected to implement as part of their construction related activities. The research question that this study aimed to answer was to determine what the challenges are that this group of stakeholders experience, based on their perspectives, in implementing environmental requirements for the construction of electricity infrastructure.

In order to address the research question, the objectives of this study were first to outline the common environmental requirements relevant to construction of electricity infrastructure, and secondly finding out from the identified group of stakeholders what implementation challenges they experienced. A qualitative research design, using the interview method, was selected as the most appropriate approach to garner in-depth perspectives and experiences from the sampled participants. Purposive sampling was used to select relevant participants who met the criteria of non-environmental team members who had to implement environmental requirements for the construction phase of electricity infrastructure projects. In-depth interviews were conducted with 24 participants, using a semi-structured interview guide comprising of both open-ended and structured 5-point Likert scale-based questions. The results from the interviews were analysed using content analysis through coding and development of themes from the responses to the open-ended questions. The Likert scale-based questions were analysed by calculating percentages of participant responses per variable.

The views shared by participants revealed 31 challenge categories from the open-ended questions, which were further categorised into seven (7) themes. The most prevalent challenge categories, where 50% or more of participants cited them as being a challenge to implementation of environmental requirements, involved focussing on financial and schedule targets, negative behaviour and attitudes, late integration of environmental requirements, poor site visibility of environmental personnel and training related challenges. The results from the Likert scale-based questions revealed that over half of the participants also agreed with the following literature derived challenges to implementation, these being:

- lack of knowledge
- other things took priority
- lack of understanding
- perception that requirements delay project progress
- lack of earlier engagement
- lack of support or resources
- perception that implementation increase costs

There were various recommendations provided by participants to address these challenges and these were captured as part of the discussions.

Mitigation of construction phase impacts are important for more sustainable practices, and this cannot be done without stakeholders who are tasked with implementing these requirements. Therefore, having insight into the obstacles faced by non-environmental project team members could reveal opportunities for improvement in environmental management of infrastructure projects.

Keywords:

Challenges; environmental requirements; construction; electricity infrastructure; perspectives; non-environmental project team members.

ABBREVIATIONS AND ACRONYMS

EMPr	Environmental Management Programme
EMP	Environmental Management Plan
EA	Environmental Authorisation
EIA	Environmental Impact Assessment
GA	General Authorisation
NEMA	National Environmental Management Act

KEY DEFINITIONS

Construction: This refers to activities on site conducted for the building or development of specific infrastructure (Du Plessis, 2002:3). This is inclusive of design activities that need to incorporate environmental considerations to be implemented on site.

Development: "*the building, erection, construction or establishment of a facility, structure or infrastructure, including associated earthworks or borrow pits, that is necessary for the undertaking of an activity*" (Department of Environmental Affairs, 2014).

Electricity infrastructure: In the context of this study, this refers to electricity distribution and transmission powerlines and substations. This excludes electricity generation infrastructure such as power stations of various kinds.

Environment: Defined in NEMA as *the surroundings within which humans exist and that are made up of:*

i) the land, water, and atmosphere of the earth
ii) micro-organisms, plant and animal life
iii) any part or combination of (i) and (ii) and the interrelationships among and between them and
iv) *the physical, chemical, aesthetic and cultural properties and conditions of the foregoing that influence human health and well-being* (National Environmental Management Act 107 of 1998 – as amended).

Environmental requirements: These are conditions or stipulations that need to be followed or implemented during the construction phase of a project, aimed at mitigating against negative environmental impacts. Environmental requirements applicable to construction of powerlines can be found in legislation, organisational policies and industry procedures (Reynders et al.,2010:5), including best practice guidelines from various sources.

Mitigation: This refers to any action, process or system put in place in order to avoid, minimise the level of, or remedy any negative impact on the environment (Marshall, 2001:196).

Non-environmental project team members: This refers to stakeholders involved in the construction of electricity infrastructure who do not have environmental qualifications or expertise to be regarded as an environmental professional. This is inclusive of project managers, engineers, contractors, construction supervisors and managers as well as general construction workers.

Project: The Project Management Institute (PMI) defines a project as work undertaken to create a unique product or service (Project Management Institute, 2022).

Sustainable construction: Du Plessis (2002:8) and Presley and Meade (2010:437) refer to sustainable construction as being a holistic process where the principles of environmental, economic and socially sustainability are integrated or applied to all activities in the construction cycle**.**

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CHAPTER 1 INTRODUCTION

The following chapter introduces the research discussion by first providing a background against which the research topic and problem statement are founded. After outlining the problem statement, the research question and related objectives to be addressed are presented. In order to frame the research direction, the scope is laid out, which is then followed by a presentation of the assumptions and limitations associated with the overall research topic. A brief overview of what contribution this research could make to existing knowledge is then outlined, followed by an explanation of the structure of the dissertation.

1.1 Background

According to the United Nations population division, the global population is projected to grow from an estimated 7.7 billion people in 2019 to around 8.5 million in 2030 (UN, 2019). This upward trajectory not only places pressure on the earth's natural systems to support more human lives, but also places a greater challenge for governments to provide basic services for their citizens. In addition to meeting the basic needs for food, shelter and access to clean water, another equally important need that has come to dominate the international agenda is access to energy. The term "energy" tends to be assigned different interpretations, depending on the subject or context it's being used in (Strydom & Cairncross, 2018:517). The definition from the physics field which Strydom and Cairncross (2018) draw upon, refers to energy as being "*the ability to do work*". This definition, however, does not adequately elaborate on what it refers to in the context of this research. A more detailed explanation, referred to by Westley (2017), defines energy as being the work and heat supplied by energy carriers. Examples of these energy carriers or sources of energy include electricity (usually a secondary energy source generated from processing of primary sources), fossil fuels, natural gas, solar radiation and wind, which are the usually primary sources of energy (Westley, 2017; Strydom & Cairncross, 2018:463; Department of Mineral Resources and Energy [DMRE], 2022). For the purposes of the discussions in this study, focus will be on electricity as the form of energy being referred to.

As the world continues to pursue the ideals of sustainable development towards improving the quality of life of people, energy, and specifically access to electricity, has become a top priority. This can be seen in the outcomes of international forums such as the World Summit on Sustainable Development (WSSD) that took place in 2002 and the United Nations (UN) Conference on sustainable development in 2012. This then culminated in access to sustainable energy being included as one of the 17 core Sustainable Development Goals (SDGs) in the UN's 2030 agenda for sustainable development (UN, 2015). More specifically, sustainable

development goal number 7 (SDG7) established at the UN's summit for the adoption of the post-2015 development agenda, refers to access to modern energy that is affordable, reliable and sustainable. The engagements at these international forums placed matters around access to energy at the forefront, deeming it an integral vehicle for sustainable development (Vera & Abdalla, 2006:155; Spalding-Fecher et al., 2005:99; Nerini et al., 2017:10). This focus was not surprising, given the cross-functional role that it plays for economic and social development, including its relationship to environmental resource use. Access to energy in the form of electricity contributes to an improved quality of life by enabling lighting, cooling, heating and cooking, to mention a few (Nerini et al., 2017:11; Strydom & Cairncross, 2018:459; Vera & Abdalla, 2006:163; Reynder et al., 2010:2). On the economic dimension, access to electricity fosters economic growth with many sectors such as industry, agriculture, residential development and commerce (Strydom & Cairncross, 2018:459) depending on it for their activities. Economic growth in a country can attract investment, which can contribute to the creation of employment opportunities, which in turn can reduce poverty, thereby also improving social development and people's quality of life. Developing countries that are in desperate need of economic growth would therefore continue to look at fast-tracking electrification projects towards improving the conditions of their societies (Vera & Abdalla, 2006:163; IEA, 2019; Spalding-Fecher et al.,2005:99).

South Africa, as a developing country, has also prioritised improved access to electricity through various initiatives. The nation is plagued with various challenges such as a concerning unemployment rate of around 34.9% at the third quarter of 2021 (Statistics South Africa, 2021) and an estimated 3 million households still without electricity (DOE, 2019).

Economic growth would therefore be one of the key priority areas required to raise levels of employment, reduce poverty and overall improvement of the living conditions of people in the country. In the National Development Plan (NDP) outlining goals to be met by 2030, investment in electricity infrastructure has been earmarked as a key contributor to address economic and social equity challenges (National Planning Commission, 2012; IEA, 2019). In addressing the household access to electricity, the target set in the NDP is that, by 2030, over 90% of the population should be connected to the electricity grid, with the remaining 10% being supplied by non-grid options (National Planning Commission, 2012). On the economic dimension, South Africa's economy is highly dependent on electricity and is quite energy intensive (DMRE, 2022; Strydom & Cairncross, 2018:460). According to statistics from the Department of Energy's 2018 figures, the sectors whose energy requirements from electricity were above 40% included mining, the non-ferrous metals sector, pulp and paper and the residential sector (DMRE, 2022). Figure 1 depicts the electricity consumed by each of these sectors as a percentage of the overall energy requirements per sector. The data presented here provides an indication that electricity plays a

crucial in South Africa's economic and social activities. As a result, the policy environment has also been adjusted in various areas to enable electricity infrastructure projects to take priority.

An example of policy-based strategies is the establishment of Strategic Integrated Projects (SIPs) according to the Infrastructure Development Act 23 of 2014. The ideology behind this special categorising of projects is that they are considered as being of priority for economic and social development and would therefore follow expedited processes to reduce the risk of possible delays. Due to the core role that electricity plays for South Africa's development objectives, projects that are related to transmission and distribution of electricity would qualify to be listed as SIPs (Infrastructure Development Act 23 of 2014). Recently, the president of South Africa made an announcement that environmental requirements towards approvals for certain electricity projects will be streamlined, in order to help address the energy crisis (South African Government, 2022). With the ground prepared through policy provisions for electricity infrastructure developments, a growing population and projections that electricity demand in South Africa is expected to grow by 1.33%-2% by 2030 (DOE, 2019), it is inevitable that more electricity infrastructure will continue to be developed.

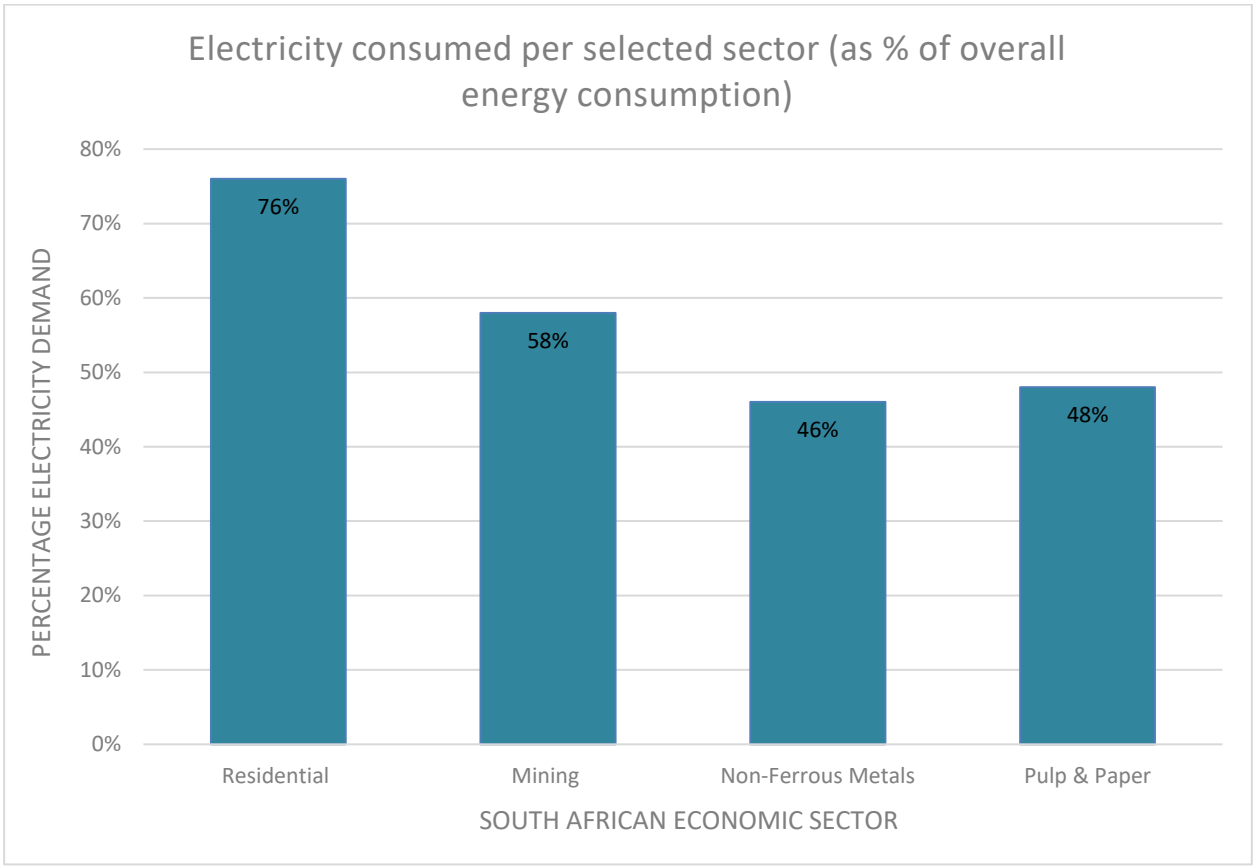

Figure 1: Electricity consumption per sector (DMRE, 2022)

It is evident from the discussions and literature that electricity does play a crucial role in the economic and social dimensions of sustainable development (Spalding-Fecher et al., 2005:99; Vera & Abdalla, 2006:156; Nerini et al., 2017:10; IEA, 2019; Reynder et al., 2010:2). However, its relationship and interaction with the physical environment dimension should not be overlooked. One of the fundamental principles in pursuing sustainable development is that economic and social development should not be pursued blindly at the expense of natural resources integrity (La Vina et al., 2003:56; Vera & Abdalla, 2006:156; UN, 2012; Strydom & Cairncross, 2018:483). Nerini et al. (2017:12) echoes this principle that the pursuit of development in other areas such as economic and social dimensions, should always be interlinked with the consideration of protection and restoration of the natural resource base.

It is not an easy feat for governments to strive to meet the energy demands of growing populations through investment in electricity infrastructure while considering preservation of the natural resource base. It is therefore imperative that, in meeting the growing demand for electricity infrastructure, the environmental impacts of constructing these assets be addressed.

1.2 Overview of electricity grid infrastructure

As populations continue to grow so does the demand for electricity and simultaneously so does the increase in pressure on the environment to support electricity production and distribution thereof (IEA, 2021). The entire electricity value chain has numerous inputs and outputs that have some interaction with the natural environment. It would be quite lengthy and beyond the scope of this research to address all the possible impacts associated with the production, transmission and consumption of electricity. The scope of this research pays particular attention to the impacts associated with the construction phase of electricity infrastructure projects. That being said, the term “electricity infrastructure” is still quite broad, as that would infer every type of infrastructure required in the value chain. For the purpose of this research context, the type of electricity infrastructure that will be focused upon is overhead power lines and associated substations for the transmission and distribution of electricity. The transmission of electricity refers to the process whereby the generated electricity is delivered from the point of generation at a higher voltage, and this voltage is reduced (at substations) to accommodate the levels required for the distribution portion where it is further transported to consumers (Energy Education, 2022). The distribution portion therefore marks the stage of the electricity supply chain where this energy is transported for consumption to end users.

In order to provide better context to the discussion, a visual representation of the electricity supply chain is presented in Figure 2 which depicts typical electricity grid infrastructure.

Marshall and Baxter (2002:747) refer to a grid as being made up of an interconnected network of electricity powerlines that connect power stations, substations and other electricity supply system infrastructure. Electricity is typically generated/produced at a power station and then transported via transmission and distribution powerlines to substations along the grid towards supplying customers. (Marshall & Baxter, 2002:747; Reynder et al., 2010:2). In South Africa, the higher percentage of electricity is typically supplied through a similar grid system (DMRE, 2022; Eskom, 2021). Grid-connection seems to be the preferred option to connect customers with the 2030 target of having over 90% of the population having grid access, as outlined in the National Development Plan (NDP) (National Planning Commission, 2012). A similar stance is held by Marshall and Baxter (2002:763) and the International Energy Agency (IEA, 2019), that grid connection, usually via overhead powerlines, is considered the most economically viable option to transport electricity.

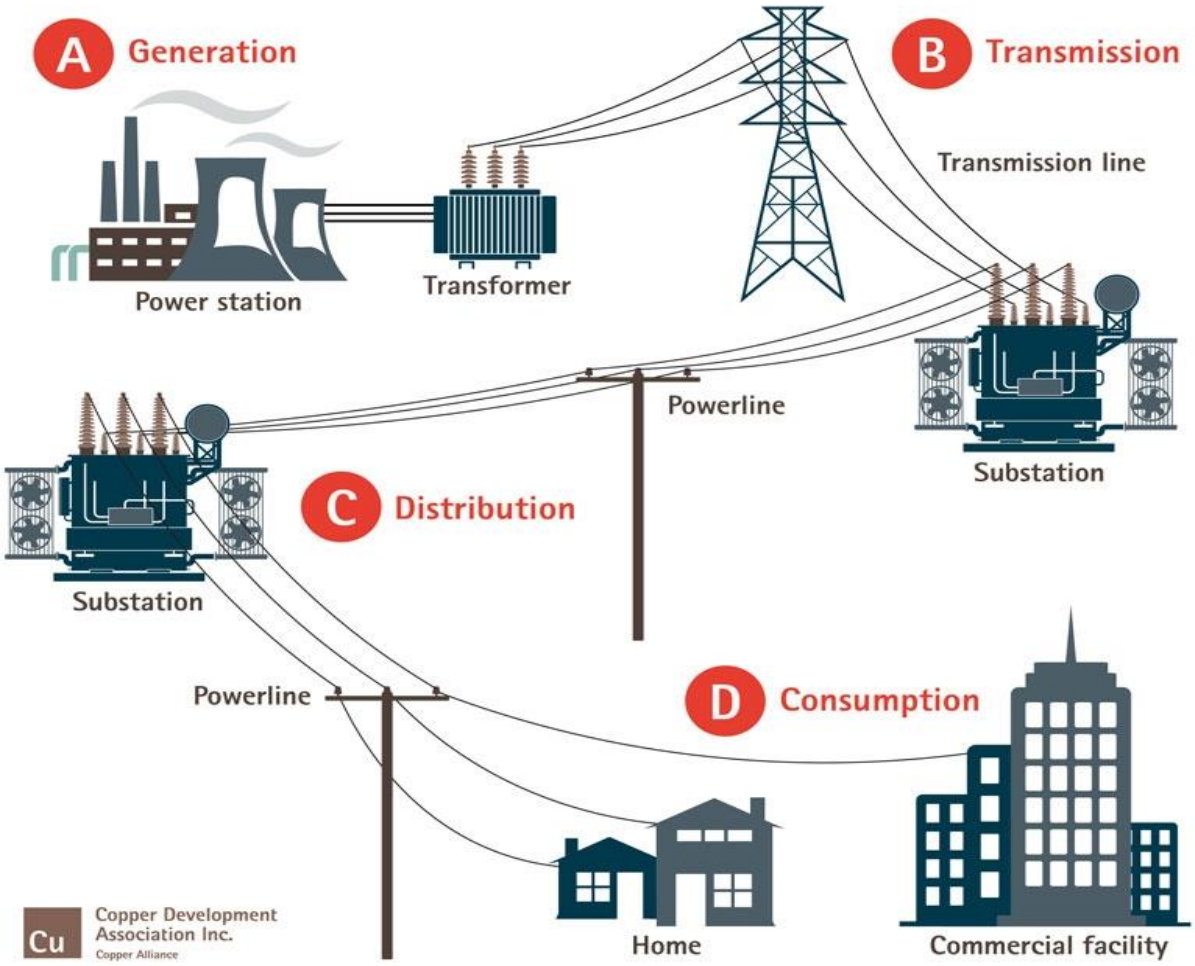

Figure 2: Common electricity supply grid infrastructure along value chain (Copper Development Association, 2022)

Substations and electricity powerlines form an integral part of the grid network. The role of substations within the grid is primarily to regulate the power, whether stepping the voltage up or down to levels required (Energy education, 2022). The overhead powerlines' role is to carry power in bulk between different substations and would typically be used to deliver this electricity to consumers at the end of the supply chain (Marshall & Baxter, 2002:747; Hyde et al., 2018:343; DMRE, 2021; Reynders et al., 2010:2). This type of infrastructure is spread out across the landscape to provide access to electricity to various parts of the country. South Africa's main electricity utility, Eskom, recorded approximately 399 546km worth of existing overhead powerlines and underground cables of various voltages, forming part of the grid across the country (Eskom, 2021a). This does not even account for the kilometres of similar infrastructure built and owned by municipalities who re-distribute the electricity to consumers in their areas of supply. The implication of this massive network of lines and substations being woven all over the

country would undoubtedly have noticeable impact on the environment. Some of these impacts are not only destructive in nature but most of them have long-term effects, most of which cannot be reversed (Vera & Abdalla, 2006:166). See Figures 3-5 showing examples of substations and powerline structures.

Figure 3: Example of bigger substation (Energy education, 2022)

Figure 4: Example of smaller substation (Energy Education, 2022)

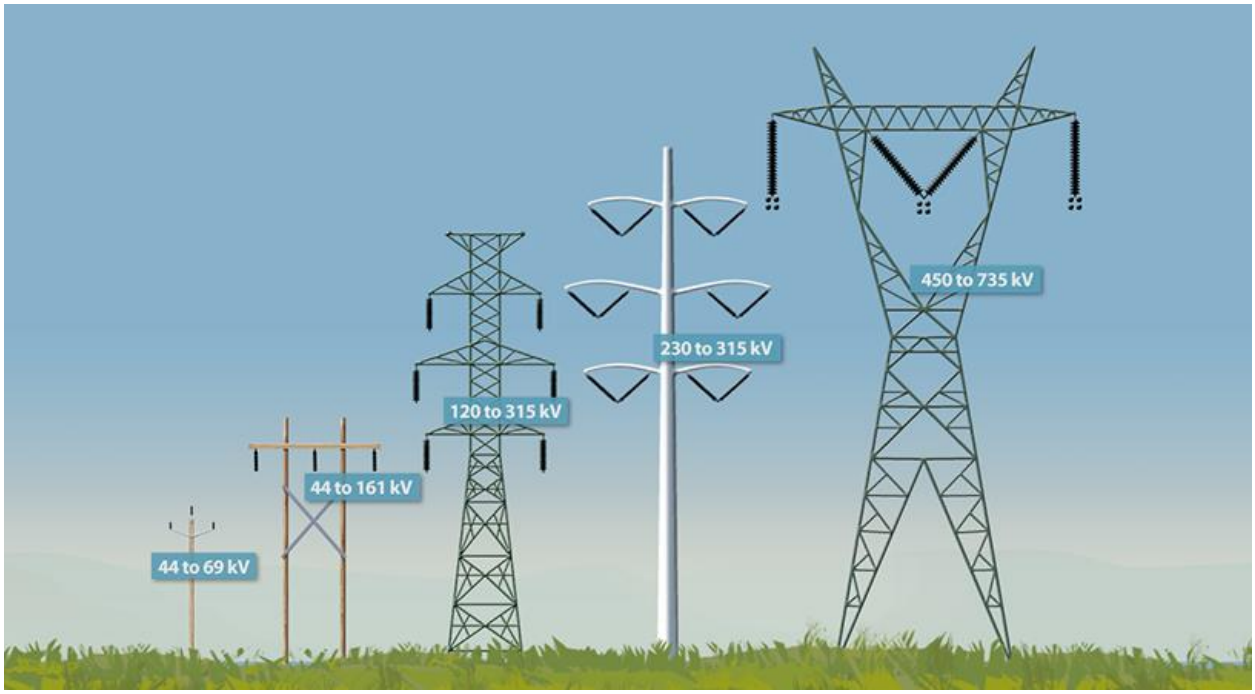

Figure 5: Examples of types of power line tower structures (Hydro-Québec, 2022)

With growing demand for electricity, there is bound to be an increase in this type of infrastructure, regardless of whether the energy is from renewable or non-renewable sources (Hyde et al., 2018:343; DOE, 2019). It is therefore worth looking at some of the environmental impacts associated with constructing this category of electricity infrastructure in effort to better provide context for the need to manage them.

1.3 Common environmental impacts associated with construction of overhead powerlines and substations

As was discussed earlier, infrastructure development is critical for economic growth and to address the social equity issues of any country. However, in the pursuit to meet the need for basic services, the management of the negative impacts of these developments on the environment also needs to take priority. Overhead electrical powerlines, due to their linear orientation, often traverse relatively long distances. Jenkins et al. (2010:263), drawing on the findings of an independent energy research company, highlighted that globally there are over 65 million kilometres' worth of powerlines of varying voltages meandering across the international landscape. The implication of the massive geographic extent of linear infrastructure is that it would affect numerous environmental features of varying sensitivities along the powerline routes (Marshall & Baxter, 2002:748). Substations, on the other hand, have impacts that are more

concentrated within a fixed location instead of being spread along vast distances. However, there are still considerably impacts that are involved in constructing them as they vary in size and footprint (see examples of substations in Figure 3 and 4). This section provides an overview of impacts on the environment commonly associated with constructing overhead powerlines and substations. It is important to note that the reference to impacts in this context focusses largely on those that can be considered as being negative to the environment. That does not infer that there are no positive or beneficial impacts associated with this infrastructure

In order to be able to provide context to the associated impacts one would first need to have an idea of the components of the infrastructure that interact with the environment during construction. Though substations and powerlines differ in footprint, the impacts are relatively similar especially since they both occupy space on the ground. Therefore, this section will address both categories and note where there are variations.

There are various types of overhead powerlines, made up of different materials, with the support structures comprising of either steel, concrete or wooden poles. See Figure 5 for examples of common power line tower types. The information in this image is purely for illustrative purposes and does not necessarily show all tower types available, nor are the related voltages particularly applicable to those used in South Africa. Apart from differences in design, material used, size etc. all powerlines will have foundations i.e. excavations made in the ground where the support structures will be planted, the tower/pole structures and the conductors which Marshall & Baxter (2002:747) describe as "*continuous wires*" that are strung between each of the electrical towers or poles.

During construction most of the impacts that take place are at the ground level as that is where the main structures and foundations of the infrastructure are concentrated. The types and levels of impacts that could occur would generally depend on the construction activities and what exists in the receiving environment affected. To be able to identify the possible impacts to the environment, a starting point would be to first outline the nature of activities that require construction. From there, one can determine which environmental receptors, as referred to by Marshall (2001:197), those activities can interact with, in order to predict possible impacts.

In order to identify these activities, the work of Cretchley and Clara (2010:117) is referred to where typical activities associated with the construction of overhead power lines are provided. It is important to note that this is simply a broad description of the common high-level activities and does not elaborate on the details within each activity.

The activities associated with power line construction include:

- Establishing of a site camp for contractors
- Clearing of vegetation for line servitude
- Pegging/marking of positions for the towers and gates
- Installing gates along the servitude
- Soil investigation/testing at foundation locations
- Excavating soil for foundations
- Transportation of people, equipment and material
- Assembling and erecting towers
- Stringing of conductors
- Installing bird guards and bird diverters
- Rehabilitation of disturbed areas after construction

The high-level activities that are associated with substation construction, according to HydroQuebec (2022) are:

- Demarcating/Fencing off the substation area
- Prepare the substation site (includes vegetation clearing, ground levelling)
- Excavate and lay the foundations (includes laying steel reinforcements, pouring concrete, building concrete structures etc.)
- Install metal wire grid underground throughout sub area
- Build the control room building
- Backfill the foundations and substation yard
- Assemble the steel structures
- Install the electrical equipment
- Rehabilitate, landscape affected area

Through the implementation of the construction phase tasks, various elements of the environment can be impacted upon. There are numerous impacts documented that do occur as a result of developing overhead powerlines. It is, however, not the intention of this portion of the discussion to give an in-depth, conclusive list of every possible impact. Rather, the idea is to provide an overview of general impacts.

Some of the associated impacts include for example vegetation loss as a result of bush clearing undertaken for servitude access to build the powerlines (Cretchley & Clara, 2010:98; Williams, 2003:2; Biassotto & Kindel, 2018:114; Hyde et al., 2018:348). The servitude or right of way (ROW) refers to the route where the line will traverse or the area to be occupied by the substation, that is usually cleared of any vegetation and other obstacles that may hinder the construction or safe

operation of infrastructure (Biasotto & Kindel, 2018:110). Vegetation clearing has a knock-on effect related to habitat destruction, as animals and birds who may have been reliant on trees and shrubs for shelter are now displaced. Another common impact is the erosion of soil that can be triggered by excavation activities from soil investigations and trenching for foundations (Williams, 2003:3; Biassotto & Kindel, 2018:115). Erosion can be exacerbated by the removal of vegetative cover, which would expose the soil to weathering agents such as wind and water. Loose soil material can also contribute to the sedimentation of watercourses, thereby resulting in degradation and pollution of watercourses such as rivers, streams and wetlands (Williams, 2003:3; Biassoto & Kindel, 2018:115). Another change that construction activities causes is to land-use patterns and availability of land for various uses. Cretchley and Clara (2010: 97) highlight this change as being attributed to the restrictions related to the type of activities that are allowed within servitudes. Often having to accommodate such infrastructure would require that other land uses, such as development of buildings or planting vegetation that pose a risk to the safe clearing distance of the infrastructure, may be hampered. These restrictions have some economic implications. One of these includes the loss of agricultural land, plantation fields or crops in order to accommodate routing and placing of power line infrastructure (William, 2003:2; Cretchley & Clara, 2010:97; Marshall & Baxter, 2002:754). Therefore, the quantity of the crop yield from the land affected by the construction, as well as the income that could have been generated from that harvest would be reduced.

In some scenarios, people can be displaced and disturbed as a result of electricity infrastructure development (Cretchley & Clara, 2010:102). These disturbances can include noise pollution generated by construction activities and hampering of other land uses/infrastructure development (Reynders et al., 2010:5; Cretchley & Clara, 2010:97; Marshall & Baxter, 2002:754), which can be categorised as social impacts. On the positive side, some communities can also benefit from temporary employment opportunities presented by construction projects that are undertaken in their communities. Another major concern people have with power line development is the perceived unsightly visual intrusion this infrastructure can be against natural landscapes (Reynders et al., 2010:5; Marshall & Baxter, 2002:748; Cretchley & Clara, 2010:97). Though it can be challenging for a substation or powerline to be sufficiently blended into natural surroundings, careful planning and proper site selection can help reduce the negative aesthetic impacts.

One of the impacts that cuts across all the activities related to powerline construction is the impact on biodiversity. The loss of plant species and habitat destruction has already been alluded to in the preceding paragraph. One of the well-researched topics related to biodiversity is the impact to birdlife (Jenkins et al., 2010:235). Though impacts such as electrocution of birds are typically prevalent during the operational phase of the line when it is energised, collision impacts can

already start in the construction phase, especially when stringing of conductors between the towers has commenced. The reasons behind incidents where birds collide with power line infrastructure can be attributed to what Biassotto and Kindel (2018:114) refer to as the "*barrier effect*". This refers to the reality that the power lines act as an obstacle to the movement of bird or animal species (Colman et al., 2012 cited by Biassoto & Kindel, 2018:114). Therefore, wildlife that may have been accustomed to move freely through a landscape would suddenly be presented with a barrier that would affect their routine movements.

Wildlife interaction with power line activities is only one category of impacts when it comes to biodiversity issues. Biassoto and Kindel (2018:112) noted that studies on this topic have shown a fivefold increase of wildlife interaction with powerlines between the years 2016 and 2019. Given the increasing prevalence of power line developments, this upward trend may continue. The literature is extensive in this area and delving into the details of what is available goes beyond the scope of this research. From the reviewed literature in this context the biodiversity related themes on the published material centre around loss of vegetation, disturbance to wildlife and birds, soil compaction and erosion concerns, reduced water quality, habitat loss and proliferation of alien invasive species (Hyde et al., 2018:344-348; Biassoto & Kindel, 2018:111-114; Marshall & Baxter, 2002:754; Williams, 2003:2-3; Cretchley & Clara, 2010:98-13; Reynders et al., 2010:5; Jenkins et al., 2010:263) .

Figure 6 extracted from Marshall and Baxter (2002:755) provides further examples of other activities and environmental impacts associated with overhead power line development. These impacts can also be applicable to substation construction. The only difference would be that a substation would impact a localised area with a wider footprint. This is different from a powerline whose footprints spreads along the length of the line with ground level impacts only taking place at specific tower locations.

The possible impacts outlined in this discussion do not reflect every single possibility that could occur. The level of impacts, apart from being dependent on the receiving environment, would also depend on a range of factors such as the construction methods employed, duration of activities, type of equipment, designs of infrastructure, size and footprint of the structures, areas that have to be cleared and technologies that would be employed. It is clear from the literature reviewed and findings highlighted here that substations and powerlines, though playing a crucial role for energy access, are associated with negative environmental impacts. However, in efforts to pursue the ideals of development without compromising the threshold of natural resources carrying capacities, understanding the factors that influence the management of such impacts plays a crucial role (Cuddihy et al., 2005:2; La Vina et al., 2003:56; Vera & Abdalla, 2006:156; UN, 2012; Strydom & Cairncross, 2018:483; Nerini et al., 2017:12).

The above discussion provided a brief outline on some of the environmental impacts that can be associated with construction of electricity infrastructure. The main purpose of the background section was to provide a backdrop against which the rationale and problem statement for this research was determined. The section that follows presents the problem statement and rationale that will guide the rest of this study.

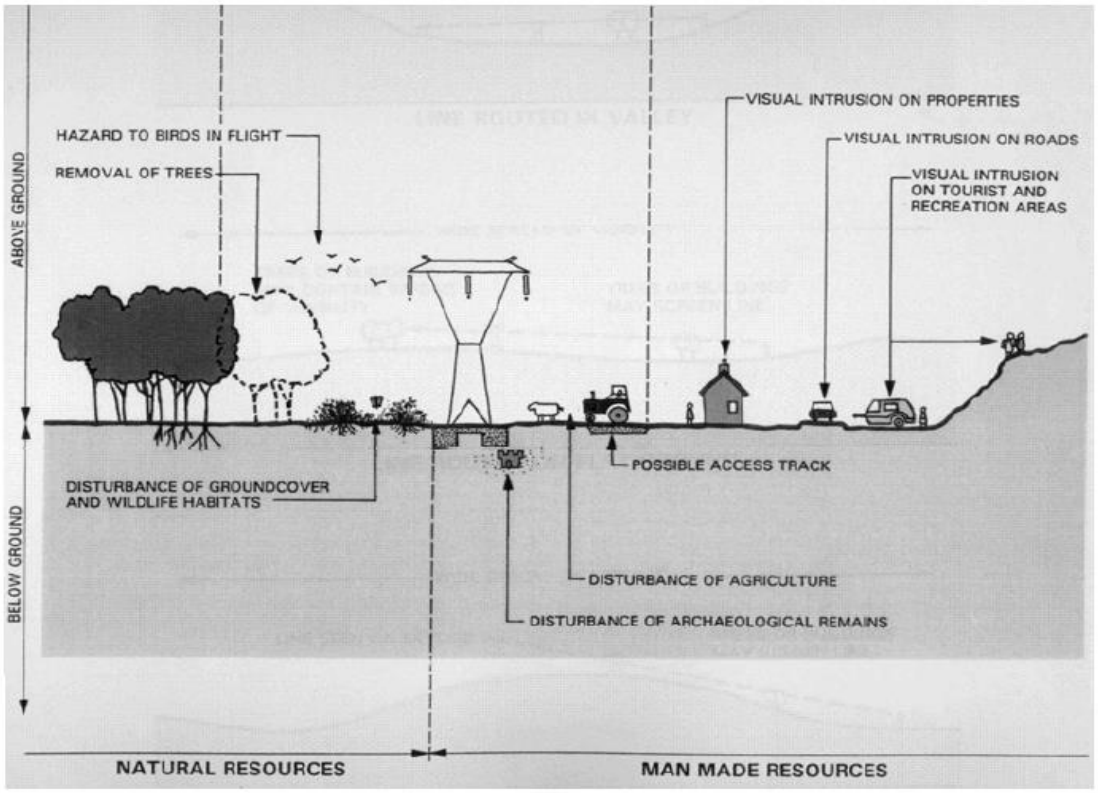

Figure 6: Common activities and environmental impacts associated with power line construction (Marshall & Baxter,2002:755)

1.4 Problem statement and rationale for the study

The previous section highlighted the crucial role electricity infrastructure plays in enabling sustainable development and ultimately improving the quality of life of people. However, in as much as the perceived value cannot be disputed, the environmental impacts associated with the increase of construction of this type of development warrant attention on how to better manage the associated impacts.

One of the underpinnings of Integrated Environmental Management is that environmental aspects and impacts associated with an activity should be managed throughout its entire lifecycle, from planning right through to closure (DEAT, 2004a:8). Before any management of actual impacts on site can be done, these would need to be identified and evaluated in the early planning phases

of the project life cycle. During this phase, studies such as Environmental Impact Assessments (EIAs), are often conducted to determine the environmental feasibility of a project. This is towards making informed decisions by assessing potential impacts upfront as a proactive approach to protect the environment from undue harm (Arts & Faith-Ell, 2012:3240; Aucamp, 2012:5; Kidd et al., 2018:1223; Oosthuizen et al., 2018:158; DEA, 2014a:3). The outcome of this phase is commonly environmental management plans, regulatory stipulations etc. in various forms that will inform the next phases of the project's life cycle in managing and mitigating the predicted impacts. Following this phase, the real test of whether the planning undertaken was of value will be seen in the implementation of those plans. Hence Marshall (2004:128) aptly expresses that "the merits of planning can only be determined at implementation". This is reiterated by authors such as Bailey et al. (1992) cited by Sanchez and Gallardo (2005:182), Marshall (2001:196) who indicate that whether EIA is effective or not will depend on how well the planned mitigation measures were implemented.

Marshall and Baxter (2001:762) including Marshall (2001:195) refer to mitigation as the actions or processes aimed at avoiding, minimising and remedying the negative effects on the environment through various means. In the case of infrastructure development, implementation of mitigation measures usually takes place during the construction phase, as that is when the actual impacts take place and would need to be managed or mitigated (Arts and Faith-Ell, 2012:3241). Therefore, effectiveness of impact management can only be evaluated when construction takes place, and the plans are executed. This stage in the project life cycle is typically environmentally destructive, with common impacts such as land degradation, pollution events, resource depletion and waste generation taking place (Aigbavboa et al., 2017:3004; Yin et al., 2018:614; Amatepey et al., 2015:1683;). As a result, the construction industry is often the subject of heavy regulation and mounting pressure to conform to environmental regulations and to conduct their activities following environmental best practice mostly aimed toward reduction of adverse impacts (Marshall, 2001:195; Marsh et al., 2020:25). The electricity infrastructure construction is no different.

With the growing advocacy for more environmentally sustainable practices, the ultimate responsibility to conform to and implement what is expected often rests with project team members who may not have the environmental expertise or fully understand the rationale behind minimising negative impacts. These stakeholders involved in the construction phase can include construction site labourers, site supervisors, construction managers, project managers and design engineers to mention but a few. For this research, this category of project stakeholders will be referred as "non-environmental project team members". These parties often have limited involvement or input into the decisions made in the planning phases but are faced with the task to implement those outcomes, whether they are impractical or not (Arts & Faith-Ell, 2012:3241).

Literature shows that there exists perceived resistance behaviours and poor implementation of environmental requirements within construction teams (Okoye et al., 2021; Sanchez & Gallardo, 2005:182; Aigbavboa et al., 2017:3004; Marsh et al., 2020:31; Amatepey, 2015:1684).

Given the integral role that the construction phase plays in the actual management of negative environmental impacts, it is important to investigate and understand the challenges experienced by the implementors in this phase from their perspectives. With the increase in demand for electricity infrastructure, it could be of benefit to understand the challenges to impact management implementation in this industry, in order to improve environmental planning and facilitate better impact management practices.

1.5 Research question and objectives

In light of the above problem statement and rationale for the study, the research question for this study is:

What are the challenges experienced by non-environmental project team members in implementing environmental requirements for construction of electricity infrastructure?

In order to answer the above question, the following objectives will be addressed through the discussions that follow:

Research objective 1: To identify common environmental requirements associated with construction of electricity infrastructure.

Research objective 2: To investigate the challenges non-environmental project team members experience that hinder successful implementation of environmental requirements for construction of electricity infrastructure.

1.6 Scope of the research

The research question looks at the challenges experienced by non-environmental project team members in implementing environmental requirements in the construction phase of electricity infrastructure. In order to define the scope or boundaries within which the research took place, the focus will be on outlining some of the key terms from the research question.

In the case of non-environmental team members, attention was aimed at members of construction teams who are not environmental professionals or do not have environmental expertise. This

typically included construction project managers, site supervisors, construction labourers as well as design engineers involved in overhead power line and substation projects. In determining the scope of what electricity infrastructure refers to, the focus for this research was on transmission and distribution substations and overhead powerlines. It was necessary to limit the type of infrastructure projects to be researched due to the variety of the types of electrical infrastructure available in the industry.

This was also influenced by the dominant exposure and understanding the researcher had in this particular category of infrastructure development projects versus others.

As already alluded to in the research topic, the development phase within which the research was framed is the construction phase of the project life cycle. Therefore, the discussions in this study paid particular attention to this stage of electricity infrastructure projects. Environmental requirements within the context of this research referred to any statutory environmental requirements, industry policies and guidelines and similar documents that outline what needs to be implemented when constructing overhead powerlines, aimed at mitigating against negative environmental impacts.

1.7 Assumptions and Limitations

1.7.1 Assumptions

The assumptions outlined here exclude those related to the methodology as those will be covered in the 3rd chapter.

In the selection of the research topic, the researcher, based on work experience in the construction of electricity infrastructure, assumed that non-environmental construction team members in electricity infrastructure generally encounter challenges in adhering to the environmental requirements for projects. This assumption was supported by literature sourced and reviewed on the topic

The literature found did not necessarily all focus on the electricity construction sector specifically but presented implementation challenges in other similar infrastructure construction sectors. However, based on the assumption that environmental impacts related to construction are fairly similar across sectors, it was assumed that the insights from the existing literature could apply to electricity infrastructure as well.

1.7.2 Limitations

Similar to the assumptions outlined above, the limitations provided here do not include those related to the methodology as those are covered specifically in chapter 3.

The researcher has only been involved in the construction of powerline and substation electricity infrastructure project teams, and is therefore not conversant with other types, such as power stations etc. Therefore, exposure to certain type of infrastructure limits the type of infrastructure projects addressed in the research. This limitation, however, did not hinder the research, as there was relevant literature available to support the research.

1.8 Potential contribution of the research

The construction industry is often in the spotlight when it comes to environmental practices, due its association with and contribution to adverse impacts on the environment (Aigbavboa et al., 2017:3004; Yin et al., 2018:614; Amatepey et al., 2015:1683). Coupled with this, is the need for more development of infrastructure that contributes to economic and social priorities.

It is important to pursue better environmental practices amidst an increase in demand for electricity access and associated developments. This is where the ideals of sustainable development come into play, where meeting current economic and social needs should always be pursued alongside considerations of the environmental effects. It is therefore important to look at issues that can affect how well measures aimed at protecting the environment are implemented during activities deemed as being environmentally destructive.

Most overhead powerline and substation projects go through some form of Environmental Impact Assessment (EIA) in the planning phases, the result of which is commonly stipulations, regulatory permits or plans that direct construction activities. Even with those that do not require an EIA, there are still environmental requirements and plans that need to be applied. These plans are generally aimed at avoiding or minimising negative impacts on the environment. As already alluded to earlier, the implementation of these plans or regulatory stipulations at construction phases of infrastructure projects often lie in the hands of stakeholders who may not have the environmental knowledge, expertise or appetite to conform to planned mitigation measures. It is therefore worth engaging with these non-environmental team members to understand the challenges experienced by them. The results of these engagements could potentially contribute towards the continual improvement of environmental management practices.

Arts et al. (2001) and Morrison-Saunders et al. (2001) emphasise the need for more focus on the post-decision phases or EIA follow-up phases, of which the construction phase is part. Marshall (2001:196) together with Sanchez and Gallardo (2005:183) also stress the important role that effective implementation of impact mitigation measures plays in contributing to the success of EIAs. The effectiveness or success of implementation can however only be assessed at the construction phase where the plans for reducing and avoiding negative impacts of developments are applied.

Lessons learnt from the implementation or construction phase of projects also speak to the element of continual improvement, which is one of the objectives of Environmental Management Systems (EMS) (Durning, 2012:8). Through gaining understanding into the hindrances to the implementation of impact management in the construction phase, areas of improvement in developing and carrying out of environmental controls can be identified.

It is therefore hoped that the insights gained through this research would add to the understanding of implementation challenges in the construction phases of infrastructure projects. This could contribute to the discussions around improving environmental management in construction of electricity developments.

1.9 Structure and outline of the research

The discussions within this dissertation are divided into five chapters as outlined below:

The first chapter provided a background to the role of the electricity infrastructure in contributing to economic and social development as well as the associated environmental impacts. Part of the initial chapter includes an introduction to the problem statement and rationale for the research, as well as associated research questions. The chapter progresses to outlining the scope, limitations, assumptions, and potential contribution of the research.

Chapter two involves the analyses of the literature reviewed in relation to the research topic. The sequence of sections of this chapter starts with discussions on matters on the need for and role of sustainable construction practices. This is followed by an overview of common environmental requirements related to the construction phase of power line developments. That section is then followed by a review of the EIA follow-up phase. The last section of the literature review involves looking at the researched challenges in implementing environmental requirements in the construction phase of infrastructure projects.

Chapter three is the methodology chapter. In this section a brief overview on the various research approaches and designs is presented. This is followed by a focus on the research design, data collection and analysis methods that were selected as most suitable to address the research question and how they were applied. The chapter also provides the ethical considerations that were taken into account as well as the methodological assumptions and limitations.

Chapter four presents the results of the data collection, including the analyses and discussion of the findings. Here, the results will also be compared with the findings of the literature review.

Chapter five is the last chapter of the thesis and provides the conclusions and recommendations. This portion of the research work will summarise the key points from the entire research and outline how the research question and objectives were met. In this chapter, recommendations for further research considerations are also provided.

1.10 Conclusion

Chapter 1 introduced the research by first providing a background on the role of electricity infrastructure in sustainable development. Against that background, the environmental impacts associated with construction of powerlines and substations were briefly discussed in order to highlight the need for impact management in the sector. The problem statement, rationale, research question and objectives were then introduced. These centred on the need to investigate the challenges experienced by non-environmental project team members when implementing environmental requirements for construction of electricity infrastructure. The scope within which the research was based was then provided followed by a summary of the associated assumptions and limitations. In order to propose the value that the research could add to existing knowledge, the section that followed involved an overview of the potential contribution of the research. In order to further guide the reader through the rest of the chapters, a sequence of the chapters or structure of the dissertation was provided.

The chapter that follows presents a more detailed discussion on the relevant existing literature reviewed for the purposes of this research.

CHAPTER 2 LITERATURE REVIEW

2.1 Introduction

One of the purposes of conducting a literature review is to place a current research study within the framework of existing literature, in order to substantiate its relevance and to establish a basis of comparison with existing findings (Boejie, 2010:21; Cresswell, 2018:26). In this chapter the literature reviewed to provide context for this study is outlined based on the key concepts related to the research question.

2.2 The role of the construction phase within project life cycle process

Construction typically refers to the site activities that are undertaken to build a structure or development (Du Plessis, 2002:3), and this is the interpretation that is used in this particular research. This phase forms part of a broader project life cycle that outlines the path that most projects follow. A project is often embarked upon to meet a certain need or to solve a problem. For example, if there is a need for electricity in an area, then an electricity infrastructure project may need to be initiated to meet that need. However, in order to arrive at the finished product of the actual infrastructure, there are processes and activities which would form part of the project-life cycle from planning right through to decommissioning that need to be undertaken.

Project development and management typically comprises four broad phases which include planning, construction or execution, operation and decommissioning (Ridgway, 1999:394; Enshassi et al., 2016:52). These phases, as depicted in Figure 7, are sometimes defined differently depending on the industries they are being applied to or the type of project being undertaken. For instance, in infrastructure projects the lifecycle process of infrastructure projects according to DEAT (2004a:9) and Enshassi et al. (2016:52) can involve:

- Concept and Initiation (including feasibility studies)
- Engineering and design
- Procurement
- Construction
- Operations and maintenance
- Decommissioning

The outcomes of each phase usually influence the phases that follow. Environmental impact assessment (EIA) for example is generally a planning phase tool but the outcomes of the process, e.g. an environmental management plan (EMP), applies to the execution/construction phase. This is typical of the Deming management model which applies a plan, do, check and act (PDCA) approach. This allows for planning of what needs to be done, implementing according to the plan, checking if implementation followed the plan (part of monitoring and control), acting on the outcomes of the checking phase and then going over the entire cycle to identify areas of improvement (Nel & Alberts, 2018:12). This implies that findings from the later phases can be integrated back to the earlier phases as well to address earlier gaps (Lenferink et al., 2008 cited by Arts & Faith-Ell,2012:3248). Therefore, the phases in the life cycle are not static but allow movement forward and backward between the phases (Arts & Faith-Ell, 2012:3248).

Figure 7: Common project-life cycle phases (Gibbs, 2020)

Projects such as those related to development of infrastructure are often associated with some environmental impacts as was highlighted in Chapter 1. In order to better plan for the management of such impacts, various environmental management tools are used during the various phases of the life cycle (Ridgeway, 1999:394; DEAT, 2004a:10). Refer to Figure 8 that depicts the various tools commonly employed along the project cycle. This is the principle behind integrated environmental management (IEM), where environmental considerations are integrated

into the entire life cycle of the project to guide the avoidance, reduction or remediation of negative impacts (DEAT, 2004a:4).

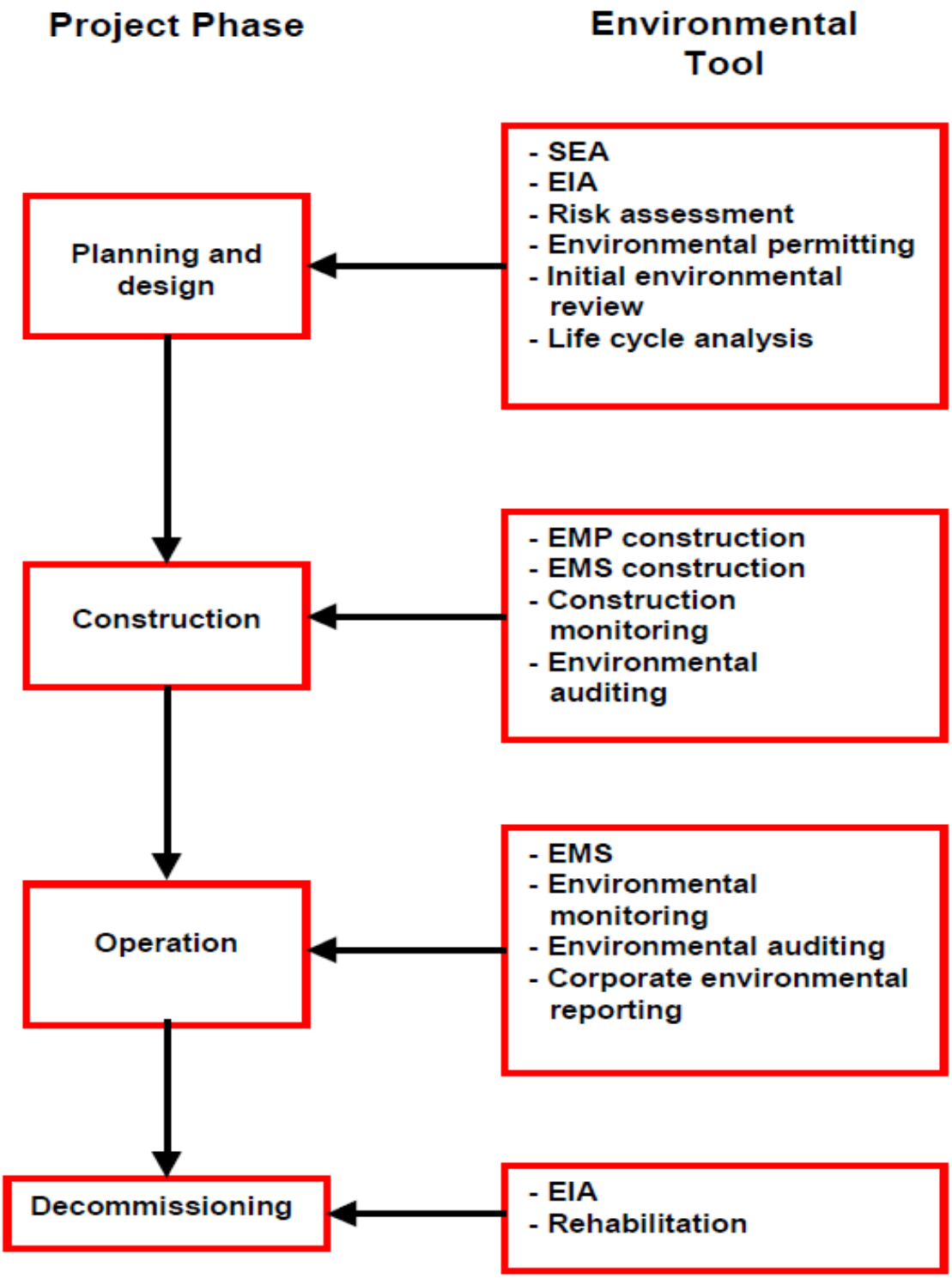

Figure 8: Examples of environmental management tools applicable to different project phases (Ridgway, 1999:395)

2.3 The role of the construction industry in sustainable development

As already highlighted in Chapter 1, infrastructure development is critical for economic and social development, will most likely be the focus of many countries, especially developing ones. With the rapid increase in global population the need for more construction projects is largely inevitable. Development for the betterment of people's quality of life is a noble cause but it cannot happen indiscriminately without considering its effects on the environment. The concept of sustainable development is founded on such a premise and has come to dominate most of the literature in the environmental management field. A famous definition of sustainable development is one outlined in the Brundtlandt report in 1987, which defined development that is sustainable as that which fulfils present generations' needs but still enables future generations to cater for their own needs (World Commission on Environment and Development, 1987). Since then, there have been numerous variations and debates around the definitions and interpretations, as highlighted by Hacking and Guthrie (2002:8) and Morrison-Saunders and Retief (2012:34). The details of the variations of sustainable development definitions go beyond the focus of this discussion. Du Plessis (2002:6) emphasises that this concept implies a process and not a destination per se. Sustainable development therefore requires ensuring that people's need for equity, prosperity and a good quality of life is balanced against the ability of ecological resources and systems to support those needs and still be able to regenerate (Du Plessis, 2002:6). There is therefore a continuous drive to address the social and economic needs with due consideration of environmental implications.

2.3.1 The need for sustainable construction in infrastructure projects

Based on a growing population, which translates to increasing demand for infrastructure development globally, the construction industry has been placed in the spotlight in relation to its contribution to sustainable development. This industry is one of the major contributors to countries' economic growth. Presley and Meade (2010:437) refers to Lindberg and Monaldo (2008), who reported that the construction industry accounted for 4-5% of the Gross Domestic Product (GDP) of the United States of America during that period when the articles were written. Similarly, Sjostrom and Bakens (1999:348) mentioned that 10-12% of the European Union's Gross National Product (GNP) was from the construction sector in the late 90's. It is likely that these figures have increased, given the rapid rate of industrialisation that continues to be present in those countries. This industry is therefore crucial in enabling the realisation of access to basic services such as water and sanitation, electricity, transport, housing and education which are all related to improvement of the quality of life of societies (Sjostrom & Bakens, 1999:348).

Notwithstanding the social and economic contributions of this industry, the associated environmental impacts are also an area of concern. Construction activities are associated with a variety of impacts on the environment. These, as previously referred to in Chapter 1, are covered by various authors. The construction related impacts include, but are not limited to, land degradation, pollution events, ecological resource depletion, waste generation and disposal, land use disturbances or disturbance to people's settlements (Aigbavboa et al., 2017:3004; Yin et al., 2018:614; Amatepey et al., 2015:1683; Du Plessis, 2002:14).

On the basis of the industry's impacts on the social, economic and environmental dimensions, it is pertinent that this sector takes an active role in improving the manner in which it conducts its activities. This call was heeded, with an example being the publishing of Agenda 21 for sustainable construction by the international council for research and innovation in building and construction, commonly known as the CIB. This document was published in 1999 following the World Commission on Environment and Development in 1987 and the 1992 Earth's summit in Rio, where Agenda 21 on sustainable development was established (Du Plessis, 2002:1; Sjostrom & Bakens, 1999:348). The CIB's Agenda 21 on sustainable construction is considered as the international construction sector's response or framework to outline how the industry aims to fulfil sustainable development imperatives through finding ways to minimise negative impacts of its activities. The concept of sustainable construction is one that Marsh et al. (2020:25) notes as not having a universally agreed upon definition. However, various authors have shared their views on what should guide its interpretation. Du Plessis (2002:8) and Presley and Meade (2010:437) refer to sustainable construction as being a holistic process where the principles of environmental, economic and social sustainability are integrated or applied to all activities in the construction cycle. Sustainable construction can therefore be interpreted as ensuring construction activities are undertaken in a manner that considers impacts on all aspects of the environment.

The interpretation of construction in this case not only focusses on the actual site activities during the building of a development. Rather, construction in this aspect involves a broader view which includes activities that come before the traditional project life cycle phases of planning, design, construction and decommissioning. This would then encompass supply chain activities, extraction of raw materials, their processing, manufacturing, assembling, construction site activities and decommissioning activities (Du Plessis, 2002:4; Marsh et al., 2020:24; Presley & Meade, 2010:437). Issues of sustainability would then have to address every aspect of these activities instead of being concentrated only to the phase where the infrastructure is physically built. Strategies for more sustainable construction practices can include opting for building materials that are more energy efficient, adopting technologies that ensure minimal waste generation or pollution, designs that blend better with the surrounding environment, promoting suppliers that

follow environmentally friendly practices to mention a few (Presley & Meade, 2010:437; Du Plessis et al., 2002:9)

The below list summarises some of the defining principles of sustainable construction as interpreted from Marsh et al. (2020:24-25), Presley and Meade (2010:436-437), Du Plessis (2002:8-9) and Enshassi et al. (2016:52).

- Sustainable construction is concerned with environmental, social and economic sustainability integrated into all activities of the construction cycle.
- Addressing sustainable practices in the broader construction cycle involve supply chain processes, stakeholder involvement, design of infrastructure, material selection, raw material extraction, processing, assembling, site construction activities, decommissioning and waste disposal.
- Aims to balance the demands of the built environment with maintaining the integrity of the natural environment.
- Emphasises minimising resource consumption, improving re-use of resources, opting for renewable resources; waste minimisation and promoting a better quality of life for people.
- The needs of current and future societies need to be accommodated.

South Africa has also placed sustainability at the core of its approach to environmental management, as can be seen in enacted legislation and associated policies. The National Environmental Management Act 107 of 1998 (as amended) is the framework legislation that guides environmental management in the country (Oosthuizen et al., 2018:128). Within this act, the ideal of sustainable development is a common theme throughout. Similar to what was highlighted by other authors referred to above, NEMA also upholds in the preamble that, in order for sustainable development to be realised, social, economic and environmental factors should be integrated into the various activities of development (NEMA, 107 of 1998). The importance of- and commitment to sustainability is further emphasised in section 2 (4)(a), where principles guiding sustainable development are outlined.

Based on the provisions in NEMA, sustainable development is promoted through an approach referred to as integrated environmental management (IEM) (DEAT, 2004a:4). This process is based on the rationale that within every phase of a project life cycle the factors pertaining to social, economic and ecological sustainability of a project should be addressed. In order to do this, there are various tools that help drive sustainability imperatives related to the activities in each phase. The same approach would then apply to any construction project including electricity infrastructure projects.

2.3.2 Relevance of sustainable construction to this research

As highlighted earlier, sustainable construction adopts a much broader interpretation of the construction life cycle. However, construction in the context of this research focusses only on the design and implementation activities that take place onsite for the building of electricity infrastructure. This is a specific phase in the traditional project life cycle that was introduced in Section 2.2 above but is still a critical phase associated with negative environmental impacts. Authors such as Marsh et al. (2020) raise the critical role of stakeholders in facilitating the success of implementing sustainable practices. Those in the industry tasked with carrying out measures aimed at moving towards more sustainable practices need to be engaged and incorporated into the journey. If not then the pursuit for development that is economically, socially and environmentally sustainable may be a futile effort. The issues of sustainable construction are of direct relevance to electricity infrastructure as well. The environmental requirements that are usually applicable to these projects are also aimed at promoting aspects of sustainability in one way or another. For instance, permit conditions related to biodiversity management may serve to ensure that the construction activities are undertaken with due consideration to protection of ecosystems in the receiving environment. It can therefore be of value to garner the experiences of implementors of these requirements in carrying out measures aimed at promoting sustainable development.

The realisation of sustainable construction requires commitment and concerted effort from all stakeholders (Djokoto et al., 2014:136; Abidin & Powmya, 2014:35, Pham et al., 2020:2995). The project environment, and specifically the construction phase, has multiple stakeholders with varying technical expertise, some of which do not include environmental management training or qualification. In order to bring this diverse team on board towards successful implementation, there are initiatives and systems that need to be put in place.

Abidin (2010:422) considers the journey to implementing sustainable construction practices as being dependent on interlinked processes. Figure 9 illustrates this by showing how stakeholders can be influenced towards positive implementation of sustainability principles in construction. The trigger that will initiate this, as presented in this figure, is awareness about sustainable construction. That implies that stakeholders will need to first be informed about the importance of implementing environmental requirements. With awareness being there, the hope is that it should generate interest on the subject matter which, should lead to stakeholders gaining knowledge. Mathur et al. (2008) cited by Wilson and Rezgui (2013:291) states that one of the ways that knowledge can be increased is through active dialogue with stakeholders. Communication of requirements should therefore not just be one-sided, where requirements are simply handed over or provided to the non-environmental professionals in this case. Rather, these stakeholders need to be engaged with on the requirements, to be able not only to understand them, but to potentially

influence them. This is supported by Durning (2012:8) who states that stakeholders should have the opportunity to determine or influence the kind of the requirements to be implemented for their activities. This is based on the rationale that they would have better insight on the intricacies of activities.

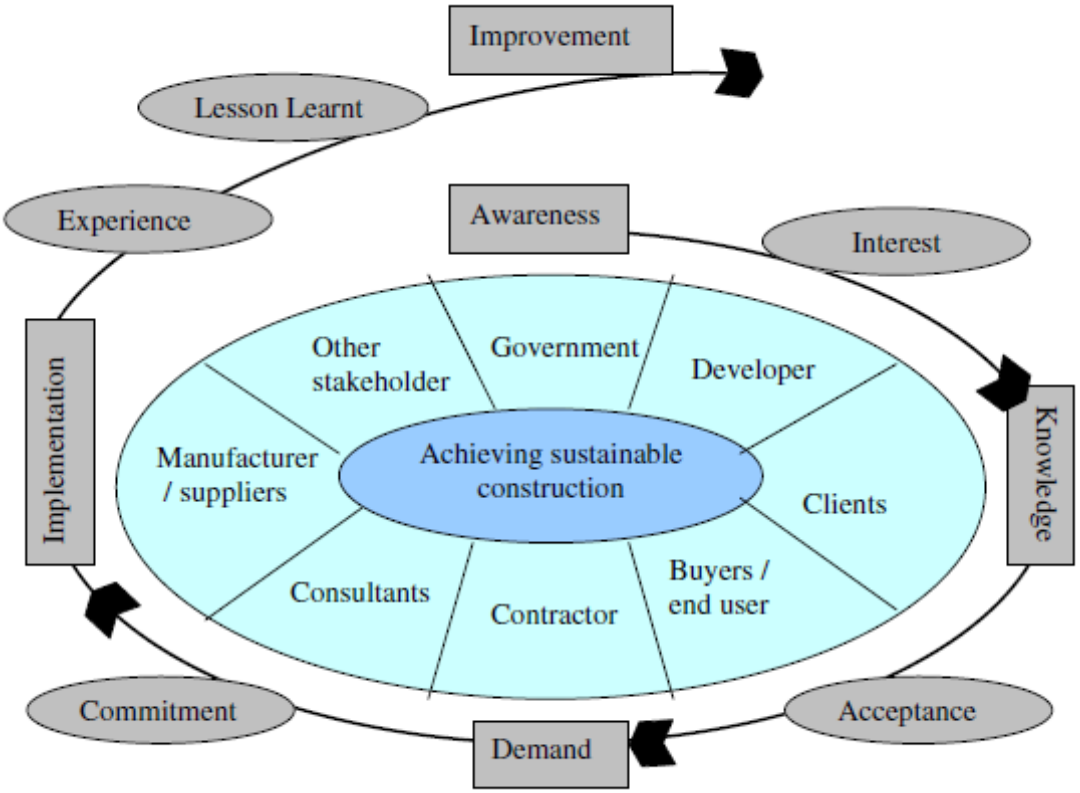

Figure 9: Stakeholder's path to achieving sustainable construction (Abidin, 2010:422)

The idea presented by Abidin (2010:422) in Figure 9 is that successful implementation of environmental requirements is only but a link in the chain process of fulfilling sustainable construction and is dependent on other factors.

2.4 Overview of environmental requirements guiding powerline construction

In order to answer the research question on the challenges in implementing environmental requirements for electricity infrastructure construction, it is important to first have an understanding of what these "environmental requirements" refer to in this context. By doing this, the first research objective will be addressed.

Environmental requirements applicable to construction of electricity infrastructure are usually found in legislation, organisational policies and industry procedures (Reynders et al.,2010:5). Environmental Management tools used in the construction phase of projects are often aimed at guiding mitigation of potential environmental impacts that have been identified or predicted at the planning phases. In the context of environmental management, mitigation refers to any action, process or system put in place in order to avoid, minimise the level of or remedy any negative impact on the environment (Marshall, 2001:196)

Environmental requirements relevant to the construction phase are typically aimed at managing the impacts that can occur during the construction phase, in order to protect the environment from undue harm. There are various environmental documents that can be used to guide impact management and mitigation in the construction phase, some of which are based on legislation, while some may be a form of self-regulation. The section that follows provides examples of these. It is important to note that the requirements included here do not encompass every possible requirement applicable to electricity infrastructure

2.4.1 Legislative requirements governing electricity infrastructure construction

Environmental management, according to Nel and Alberts (2018:1) and Oosthuizen et al. (2018:135), has to do with the control or management of people's interactions with the environment. There are various means in which this can be fostered and one of these is through enacted legislation. These legal provisions are often mandatory and should be adhered to, as non-compliance to them often results in punitive measures.

Development of electricity infrastructure, due to its associated environmental impacts highlighted in Chapter 1, is managed through numerous environmental legislations. The implications of compliance to legislation often translates to conditions or requirements that also govern construction activities. The purpose of this section is to briefly outline what some of these environmental legal provisions are in relation to the construction phase. There is a plethora of environmental legislation in South Africa, and it will not be practical for the purpose of this research to delve into each one. Therefore, focus will be on a select few that relate to the common impacts identified in Chapter 1. Even with those mentioned, the intention is to provide an overview of how they can influence construction activities for substations and power lines.

2.4.1.1 Requirements emanating from Environmental Impact Assessment (EIA) regulations

Development activities that have a potential to have significant effects on the economic, social and biophysical environment are commonly subjected to a level of environmental assessment prior to their commencement. A popular form of assessment typically used in environmental management is Environmental Impact Assessment (EIA). Though various definitions in literature, EIA can be summarised as the process for assessing upfront the possible effects a proposed activity can have on the biophysical, social, economic and cultural environment (Aucamp, 2012:5; Kidd et al., 2018:1223; Oosthuizen et al., 2018:158).

The International Association for Impact Assessment (IAIA) is an internationally recognised authority in impact assessment and their definition from their best practice guideline on EIA elaborates further on the processes by referring to EIA as the “process of identifying, predicting, evaluating and mitigating the biophysical, social and other relevant effects of development proposals prior to major decisions and commitments being made” (IAIA & IEA, 1999). Based on this definition and objectives of EIA set out in the aforementioned best practice guideline, EIA does not only serve to assess possible adverse effects or impacts but also guides the mitigation of those predicted impacts with the aim being to protect the environment from excessive harm.

Environmental Impact Assessments (EIAs) in South Africa are regulated under the National Environmental Management Act (NEMA) 107 of 1998 (as amended). Section 24(5) of NEMA makes provision for EIA regulations to be promulgated and the regulations that are currently in effect are published as Government notice (GN) 982 and referred to as the NEMA: EIA regulations,2014 (as amended). Within these regulations, there are development activities that are part of listing notices 1-3 outlined in Government Notice 983, 984 and 985 of the aforementioned EIA regulations. Before any of the activities that are listed can commence, an EIA needs to be undertaken towards obtaining an Environmental authorisation (EA) from the regulating government authority (Oosthuizen et al., 2018:160).

The development of certain categories of electricity infrastructure also forms part of activities that require an EIA. Table 1 provides examples of activities commonly applicable to electricity infrastructure. It is important to note that these are not the only activities requiring an EIA that may relate to the construction of overhead powerlines.

As mentioned earlier in Chapter 1, the linear nature of powerlines often results in the infrastructure's construction activities and -footprint interacting with various environmental features along its route (Marshall & Baxter, 2002:748). Therefore, even if a proposed development's voltage threshold does not trigger a listed activity requiring an EIA to be conducted according to the regulations, other aspects of the activity may require an EIA. This is also applicable to substation infrastructure. For example, if the construction requires a certain volume of soil material to be excavated from a watercourse, and this activity is listed in the regulations, then an environmental authorisation would need to be applied for because of that activity.

There are often other services or activities that are related to the physical construction of the infrastructure. These can include development of roads, establishing of site camps and areas where export soil or material can be sourced from that may need borrow pits to be established. These are examples of some of the complexities of infrastructure developments that have a range of associated services, each with their own set of impacts and legislative requirements.

Table 1: Examples of activities related to powerline infrastructure requiring EIA (NEMA: EIA regulations 2014 as amended)

Listing Notice number	Activity number in listing notice	Description of activity specifically referring to power line infrastructure
1	**11**	The development of facilities or infrastructure for the transmission and distribution of electricity- (i) outside urban areas or industrial complexes with a capacity of more than 33 but less than 275 kilovolts; or (ii) inside urban areas or industrial complexes with a capacity of 275 kilovolts or more; excluding the development of bypass infrastructure for the transmission and distribution of electricity where such bypass infrastructure is- (a) temporarily required to allow for maintenance of existing infrastructure; (b) 2 kilometres or shorter in length; (c) within an existing transmission line servitude; and (d) will be removed within 18 months of the commencement of development.
1	**12**	The development of-(i) dams or weirs, where the dam or weir, including infrastructure and water surface area, exceeds 100 square metres; or (ii) infrastructure or structures with a physical footprint of 100 square metres or more; where such development occurs- (a) within a watercourse; (b) in front of a development setback; or

		(c) if no development setback exists, within 32 metres of a watercourse, measured from the edge of a watercourse;
1	**47**	The expansion of facilities or infrastructure for the transmission and distribution of electricity where the expanded capacity will exceed 275 kilovolts and the development footprint will increase.
2	**9**	The development of facilities or infrastructure for the transmission and distribution of electricity with a capacity of 275 kilovolts or more, outside an urban area or industrial complex excluding the development of bypass infrastructure for the transmission and distribution of electricity where such bypass infrastructure is- (a) temporarily required to allow for maintenance of existing infrastructure; (b) 2 kilometres or shorter in length; (c) within an existing transmission line servitude; and (d) will be removed within 18 months of the commencement of development.

Following the assessment phase of the EIA, reports are submitted to the relevant government authority for decision making pertaining the proposed development. The decision that the authority will have to deliberate upon is whether to grant or refuse authorisation based on the findings from the environmental assessments. Section 24O of NEMA outlines the factors that need to be taken into consideration in making the decision towards the development as including but not limited to:

- environmental impacts that may result if the authorisation is granted or refused
- measures that will be taken to protect the environment from harm
- measures to avoid, control or mitigate any possible negative impacts
- ability of applicant to implement the proposed mitigation measures and any other conditions accompanying the approval

When looking at the above points, management of impacts appears to play a critical role in the decision to grant an authorisation. How well mitigation measures are implemented has come to receive attention as one of the "measuring sticks" for the effectiveness and value of EIA (Marshall, 2001:197; Sanchez & Gallardo, 2005:182), which only makes sense, since it is of little value if potential impacts were identified and ways to avoid, minimise or control those have been proposed yet do not get implemented.

Should the result from the decision-making process be positive and the proposed development be given the go-ahead, this is often accompanied by documents that will need to be implemented in the construction of the infrastructure. For this research, focus will be on two typical documents emanating from the EIA phase and that form part of the regulatory control documents for project construction. These are the environmental authorisation (EA) and the environmental management programme (EMPr) which are discussed briefly below.

a) Stipulations in Environmental Authorisations applicable to construction phase

An EIA is commonly undertaken with the aim, from a developer's perspective, to obtain approval from a decision-making authority to proceed with an activity. In the event that the outcomes of the assessment phase are accepted by the relevant government authority, referred to as the competent authority in terms of the NEMA: EIA regulations 2014 (as amended), an environmental authorisation (EA) is then issued as proof of approval.

The EA is not simply a ticket to proceed with development but is a legally binding document that has conditions that need to be complied with (Kidd et al., 2018:1262). Regulation 26 of the NEMA: EIA regulations 2014 (as amended) outlines the minimum

content requirements that should be incorporated into environmental authorisations. This includes any conditions that relate to the management, mitigation and monitoring of environmental impacts (over and above those included in the environmental management programme) throughout the life cycle of the development according to regulation 26 (d)(iv) of the aforementioned legislation.

The requirements outlined in the EA become one of the regulatory benchmarks against which compliance to environmental stipulations needs to be measured (Wessels & Morrison-Saunders, 2012:4). Teams involved in the construction phase for projects for which an EA was issued would therefore need to be involved and engaged on the environmental expectations related to this phase. Failure to comply with the conditions of the EA carries legal consequences which can include fines and imprisonment (Oosthuizen et al., 2018:162). The implications of legal contraventions related to this also has consequences for project progress. Projects can be halted, resulting in delays with far-reaching effects such as financial losses and reputational damages including environmental degradation that could have been avoided.

The ideal of using the EA as one of the tools aimed at environmental impact management in construction activities holds merit, but to what extent are those conditions complied with? Setting of conditions is ultimately not a guarantee of their implementation (Kidd et al., 2018:1263). There is a concern that there is often poor monitoring of implementation and enforcement of compliance to these conditions, which may simply remain as paper exercises (Wessels & Morrison-Saunders, 2012:4; Sanchez & Gallardo, 2005:152). To have unaddressed gaps in monitoring post-authorisation activities could end up compromising the potential value and purpose of EIA in contributing to effectively minimising negative impacts.

It is therefore prudent to give more attention to the challenges during implementation phases of development activities i.e. after authorisations are issued. If this can be pursued, then hopefully better insight can be gained through engaging with people tasked with implementing the conditions and this could contribute to improving impact management in projects.

b) Stipulations from Environmental Management Plans applicable to construction phase

The environmental authorisation (EA) is not the only document that provides guidance on the mitigation and control of identified environmental impacts relevant to the construction phase. Other commonly utilised tools are environmental management programmes (EMPr's) and environmental management plans (EMPs).

Before outlining what these documents refer to, it is important to first note that EMPr/EMPs can either be part of a legislative requirement or a voluntary based and best practice tool. The differences will be highlighted later on in the discussion, once the purpose of these is provided.

Often the terms EMPr and EMP are used interchangeably and considered as referring to the same thing. However, DEAT (2004b:4) outlines that an environmental management programme refers to the overarching framework on how environmental management will be undertaken in the implementation phase. Then, within such a framework, especially for projects that have numerous environmental features or complexities to consider, individual environmental management plans can be included which may address specific implementation activities such as having a waste management or water management EMP (DEAT, 2004b:4; Durning, 2012:3). There can also be different types of EMPs relevant for activities during various phases of the project life cycle such as a construction EMP, operational EMP and decommissioning EMP (DEAT, 2004:7; Durning, 2012:6). The intention in this discussion is not to unpack or debate the semantics of the differences in EMPr and EMP types or definitions. For the purpose of this research these terms will be used interchangeably. This approach is based on their relation to their purpose, which is to guide environmental impact mitigation, controlling, monitoring and supporting compliance with legislation in the construction phases of infrastructure projects (DEAT, 2004b; Broderick & Durning, 2006:16; Durning, 2012:4; Marshall, 2004:141).

The conceptual framework of EMPs/EMPr according to Durning (2012:2) dates back to the early 1990s where the environmental regulatory agencies in England and Wales introduced environmental action plans (EAPs). The content of these plans included how matters related to protecting the environment through mitigation of impacts will be performed. The naming evolved to "environmental mitigation plans" in the World Bank's environmental assessment directive in 1991 and then to "environmental

management plan" in 1999 (Durning, 2012:1-2). Irrespective of the naming convention, the rationale is that these tools outline measures related to impact management to promote minimal degradation to the environment.

In terms of their reference to the project life cycle phases, EMPrs and EMPs connect the predicted impacts and associated mitigation processes identified in the planning phases with the actual activities of the construction phase (World Bank, 1999 cited by Durning, 2012:1; DEAT, 2004b:4; Marshall, 2004:143). EMPs therefore translate the predicted impacts and recommended mitigation measures from the planning phases into a more detailed action plan. Broderick and Durning (2006:16) also refer to EMPs as serving as an "operational manual" to guide the implementation of monitoring and control measures for the construction phase. Measures related to compliance to environmental legislation and best practice applicable to this phase can also be guided through EMPs (DEAT, 2004b:2; Broderick & Durning, 2006:16)

According to DEAT (2004b:6); Durning (2012:3-4) and section 24N(2) of NEMA 107 of 1998 (as amended) the contents of EMPs can include as a minimum:

- Summary of predicted impacts
- Description of mitigation measures relevant to the possible impacts
- Programme on how implementation will be monitored including indicators to be monitored
- Responsibilities assigned for the various actions
- Legal requirements to be complied with in relation to EMP contents
- Implementation schedule comprising of the timing, frequency and duration of mitigation
- Objective and targets to be met to minimise or avoid negative impacts

Now that the conceptual framing of what EMPrs/ EMPs refer to has been provided and the purpose thereof, the next section will look at the provisions for these as a legislative requirement and a voluntary tool.

a) EMPr's as a legislative requirement

Environmental Impact Assessment (EIA) processes in various countries have over the years incorporated EMP as part of legislative requirements. This is the case in the South African legislative context where projects requiring an EIA are mandated to have an EMPr. According to section 24N (1A) of NEMA 107 of 1998 (as amended) an EMPr is required for projects for which an EIA is undertaken. Appendix 4 of the NEMA EIA regulations of 2014 (as amended) outlines the content requirements of EMPs that need to accompany EIA applications. As per requirements of section 24N(1A) of the aforementioned legislation, the EMPr submitted to the regulatory authority will serve as one of the documents that will guide decision making towards the granting of an environmental authorisation for the proposed project. By approving the proposed projects and issuing the environmental authorisation, the EMPr that accompanied the application is also often approved in tandem (DEAT, 2004b:7). The approved EMPr then also becomes a regulatory permit that has conditions that will need to be complied with similar to the environmental authorisation. In other words, the approved document will be considered as one of the compliance obligations against which the project's environmental performance will be measured.

For the construction phase, the EMPr is used as one of the key operational tools for environmental management as its content will direct how activities in this phase are to be undertaken in a manner that minimises negative impacts. The integration of the need for an EMPr as part of the legislated EIA process can serve to provide some assurance that mitigation has been addressed and provided for (Broderick & Durning, 2006:23; DEAT, 2004b:4). In addition, developers are left little room to evade taking responsibility for the impacts of the projects, as the approval of their projects is intertwined with the implementation of the EMP conditions (DEAT, 2004:6). The EMPr would be enforceable by law and non-compliance to it carries legal consequences. The integration into the legal framework should encourage behaviour by all parties that is more environmentally responsible. Another benefit of an EMPr is that it allows for the consolidation of all approval and mitigation requirements into one document that can be used in the construction phase (Marshall, 2004:129).

According to the World Bank's (1999) guidance on EMPs, these documents do not always have to follow a standard, universal format and can be written according to a specific context (DEAT, 2004:6). In this case, context can possibly be interpreted

as referring to the type of activities for which an EMP is required and possibly if there were any specific requirements it would need to meet.

In the case of electricity infrastructure in South Africa, there are EMPs that have been published that must be utilised for all powerline and substation projects for which an EIA is required. The generic EMPr's were promulgated into legislation in March 2019 in terms of section 24 of NEMA in government gazette 42323.

b) EMPr's as self-regulatory tools

Some projects do not require formal EIA as they may not trigger any listed activities outlined in the legislation and therefore EMPr requirement in this context may not apply. Similarly, other sector specific legislation may not require an EMPr to be submitted for approval. Section 28 of NEMA refers to the duty of care principle which in summary outlines the importance of taking reasonable measures to prevent, minimise and rectify environmental degradation (NEMA, 107 of 1998 as amended). Secondly, Smit (2020:60) refers to section 24 (b) of the South African constitution which refers to the right to have the environment protected through legislative and other measures (Constitution of South Africa,1996). This implies that legislation is not the only determining factor to guide protection of the environment. EMPrs can therefore be useful tools to guide impact mitigation for overhead powerline projects which may not have required undertaking a legislated EIA process, or where the EMPr was not required according to other regulatory policies.

In the project environment, having a site-specific EMP can serve as a beneficial tool for managing environmental risks. One of the benefits is that it provides the opportunity to establish mitigation measures for emerging risks and impacts that often arise in a dynamic project environment (Marshall, 2004:138). Even if not required by law, the use of self-regulatory tools is also beneficial to corporate image and can be a sign of being environmental responsible in the execution of projects.

c) The role of implementation stakeholders for EMPr effectiveness

It is the ideal that what has been committed to and is legally enforceable, is implemented as such. There are, however, many factors that can possibly influence how effective implementation is and the human factor is a key component. At the end of the day EMPrs are documents that have the potential value to effectively influence mitigation of negative impacts towards averting

excessive degradation. However, the realised value of their contents and measures lies in the hands of the people tasked with implementing them.

The generic EMPrs for overhead powerlines and the one for substations published by DFFE outlines the roles and responsibilities for its implementation. Some of these responsibilities lie with personnel who may not have qualifications in environmental management. These include stakeholders such as the project managers, site supervisors and contractors who are tasked with the day-to-day construction operations. In the section of roles and responsibilities for implementation of the generic EMPr, the roles of the following non-environmental project team members are outlined as per (Department of Environmental Affairs, 2019) as follows:

- **Project manager**: Accountable to complying with the EMPr. This responsibility extends to ensuring that the conditions to be implemented from the EMPr are communicated with the developer and adhered to. This stakeholder must also ensure that implementation is monitored and evaluate environmental performance based on how well the project conformed to EMPr requirements.

- **Site supervisors**: Responsible for the daily implementation of the EMPr requirements including ensuring that construction workers under their authority also conform.

- **Contractor**: Has the ultimate responsibility to ensure that all construction activities are undertaken in line with the requirements outlined in the EMPr. This includes draft method statements that detail how the mitigation measures will be applied.

The stakeholders listed above are commonly more conversant with the technical aspects of construction activities. In addition to their primary professional capabilities, they often have to bear the additional responsibility of ensuring environmental requirements are adhered to, which is often beyond their scope of education or professional expertise. It is therefore important that they not only know, but also understand and are accepting of the environmental requirements they are entrusted to fulfil (Broderick & Durning, 2006:23).

2.4.1.2 Permit conditions from other environmental legislation

As highlighted earlier, overhead powerlines, due to their linear nature, often traverse and have an impact on various environmental features. Similarly, substations are often built and impact upon different receiving environments of varying sensitivities. South Africa's legislative environment is riddled with various sector specific legislation addressing diverse environmental elements. Some of these Acts and Regulations require that permits be obtained from the relevant government authority where an activity may impact on a specific environmental element. The legal permit conditions can also apply to the construction phase activities and will need to be complied with. The below list provides examples of various sector environmental management acts (SEMAs) applicable to construction of electricity infrastructure where there may be requirements for permits to be obtained:

- **National Water Act 36 of 1998 (as amended) including associated regulations**: requirement for water use license when constructing in regulated area of water course.

- **National Heritage Resource Act 25 of 1999 (as amended) including associated regulations:** may require heritage permit if impacting on certain heritage features.

- **National Environmental Management: Waste Act 59 of 2008 (as amended) including associated regulations:** requirement for waste license for certain activities outlined in regulations.

- **National Environmental Management: Biodiversity Act 10 of 2004 (as amended) including associated regulations:** vegetation removal/translocation permit for listed biodiversity species.

- **National Forestry Act 84 of 1998 (as amended) including associated regulations:** Tree cutting permit for removal or cutting of listed protected trees.

2.5 Understanding challenges in implementation practice in relation to follow-up/post decision phase

Marshall et al. (2004:128) stated that the value of planning can only be seen in the execution or implementation phase. Detailed plans can be established on how to manage environmental construction impacts, but it is how well those plans are implemented and how effective they were in minimising unnecessary environmental degradation that is important (Morrison-Saunders & Marshall, 2004:8; Marshall, 2004:133). In order to be able to assess the effectiveness of a plan, it is necessary to assess what is executed against what was planned. To do this, processes would need to be undertaken to find out or "follow-up" what has happened after the planning phases of the project.

In this section, the focus is on follow-up practices and their relevance to the construction phase of projects. The first section will provide an over-view of what follow-up refers to and how it relates to this research.

2.5.1 Defining follow-up and purpose it seeks to achieve in environmental management

The accepted definition of follow-up emanates primarily from EIA literature where it refers to EIA follow-up as entailing "monitoring and evaluation of the impacts of a project of plan (that has been subjected to EIA) for management and communication about the environmental performance of that project or plan" (Morrison-Saunders et al., (2007:1). The focus of the interpretation of follow-up in this discussion will be on the project level.

Since the definition refers to "monitoring and evaluating the impacts" of a project, this implies that these activities are undertaken at project implementation or execution when the actual impacts occur. This therefore places follow-up in the post-planning phase of the project life cycle, after necessary environmental approvals are granted authorising implementation to proceed. In the context of electricity infrastructure projects, the implementation phase would be the construction phase. Marshall (2004:118) interprets this in the same way by indicating that the process of follow-up is concentrated in the construction phase and continues into the phases that follow in the project life cycle i.e. operation, decommissioning and rehabilitation. This relates to principle 16 of the best practice principles which speaks to integration of follow-up practices within the entire project-life cycle of the activity (Morrison-Saunders et al., 2007:3).

Though the implementation of follow-up may take place from the construction phase, it would need to be planned for already in the early phases, such as in the screening and scoping phases, so as to ensure it is accommodated in the later project phases (Morrison-Saunders et al., 2021:8). Accommodating follow-up in this case can include for example ensuring human and financial resources are available or policies are drafted to enable its implementation.

In order to better explain the processes involved in conducting follow-up, authors, inclusive of Morrison-Saunders and Arts (2004:4-5); Marshall et al. (2005:176); Morrison-Saunders et al. (2007:1) and Pinto et al. (2019:2) provide a summary of the defining elements outlined below:

- **Monitoring**: Refers to collecting baseline data before impact management controls are applied and after application. Pinto et al. (2019:8) emphasises that monitoring should focus on those impacts that were rated as significant during the assessment phase, including those that became significant during project implementation.

- **Evaluation**: Refers to rating how well the project performed in relation to set criteria, expectations or standards. An example of this may be compliance auditing undertaken by checking if the project activities are complying with permit or authorisation conditions.

- **Management**: This step involves looking at the results of the monitoring and evaluation processes and then taking the necessary action or steps to address those findings (Morrison-Saunders & Arts, 2004:4). These decisions may include for instance adjusting proposed mitigation measures to better address an impact if the initial mitigation proposed was ineffective.

- **Communication**: Involves informing relevant stakeholders of the results of the outcomes of the follow-up (Morrison-Saunders et al., 2007:1). Engaging stakeholders in the follow-up process can contribute to people having better understanding of the objectives of the EIA processes, which can empower them for future projects (Pinto et al., 2019:11).

- **Governance:** Most of the literature on EIA follow-up only outline the 4 elements outlined above. Pinto et al. (2019:2) introduced this 5th one to address the arrangements that must be put in place in order to facilitate implementation of the follow up process (Morrison-Saunders et al., 2021:3)

When interpreting the above-mentioned processes, they have linkages to the Deming management cycle referred to in the beginning of this chapter. The monitoring and evaluation aspects have a direct relation to the "check" activity of the PDCA cycle. By undertaking these activities, follow-up enables one to check whether construction practices or impacts that have taken place are as predicted or planned for in the earlier phases. The management aspect then relates to the "act" phase of the management phases as decisions or actions would then need to be made in response to what was found. Some of these actions can include revisiting decisions made in the planning phase in order to improve processes. This speaks to one of the major potential benefits, key goal and well recognised principle of follow-up, which is learning from experience towards continual improvement (Morrison-Saunders & Arts, 2004:6; Marshall et al., 2005:177; Morrison-Saunders et al., 2007:3; Morrison-Saunders et al., 2021:7).

The learning that follow-up enables can take place in and relates to different contexts. For instance, Marshall (2004:118) makes reference to its contribution to improvement of mitigation measures for development projects. This is a point raised by Arts and Faith-Ell (2012:3241) who indicates that sometimes measures proposed at the planning phase are not practical to implement at the construction phase. However, it would not be easy to identify such discrepancies if follow-up is not done. Improvements that can positively influence future similar projects can also be discovered through follow-up activities in current projects (Morrison-Saunders, 2021:7). Therefore, shortfalls discovered in past projects can contribute to planning for or avoiding risks in future projects. The application of knowledge gained through follow-up can be fed back into improving and revising the planning process, a process that Arts and Faith-Ell (2012:3250) refers to as "backward integration".

The movement of activities through the project lifecycle is commonly in a forward sequence, where the outcomes of earlier phases influence the ones that follow. However, follow-up enables a two-way flow of information that can strengthen the different phases. See Figure 10, which depicts the forward and backward linkages promoted through follow-up.

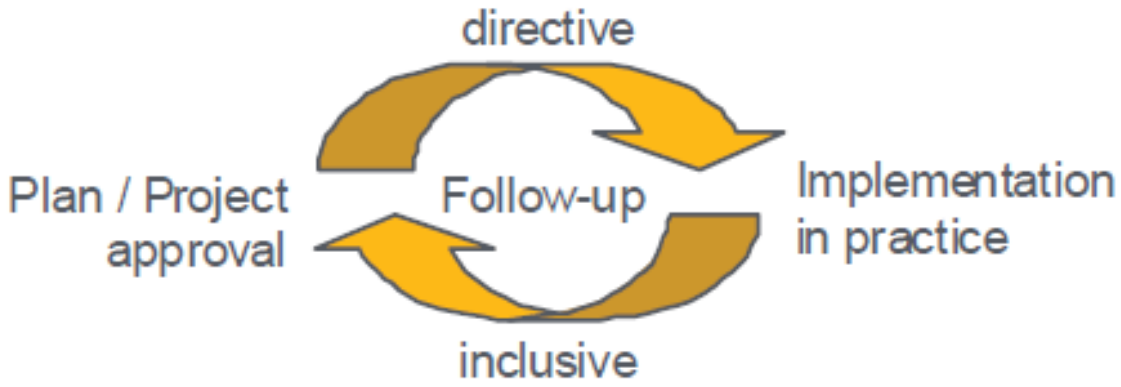

Figure 10: Flow of information between planning and implementation phase through follow-up (Arts & Faith-Ell, 2012:3248)

By integrating lessons learnt from the implementation phase into planning can improve planning tools such as EIA and possibly add value to their effectiveness (Morrison-Saunders & Arts, 2004:7). There are many other benefits of EIA follow-up, but it is not within the scope of this study to unpack them.

The focus on the "learning from experience" aspect of follow-up is of relevance to this study. The research question seeks to determine the challenges faced by non-environmental project team members in implementing environmental requirements. This related to follow-up as it involves engaging with stakeholders involved in the construction phase, in order to gain insights on the challenges encountered by applying requirements that were most likely determined in the planning phases of the project. The information from this engagement could contribute towards improving environmental management practices and probably influencing activities undertaken in the planning phases. One of the questions that the monitoring and evaluation part of follow-up seeks to answer is around whether the impacted environment was managed in an acceptable way (Morrison-Saunders et al., 2021:3). The research topic and question expand on this by seeking to uncover the obstacles relating to management of impacts in the construction phase. Therefore, the research essentially "follows-up" on the implementation of environmental requirements determined at the planning phase by exploring challenges to their application in the construction phase.

Though not all electricity infrastructure projects have to go through the EIA process as outlined in the previous sections, the principles of EIA follow-up can be applied to any other project to achieve similar benefits. Morrison-Saunders et al. (2004:13) highlights the use of self-regulatory tools such as Environmental Management Systems (EMS) to facilitate follow-up. Marshall (2004) provided

an example of this where Scottish Power, an electricity company in the United Kingdom, used Environmental Management Plans to integrate self-regulation with EIA follow-up. Even if a project did not have to undergo EIA there are always environmental impacts that will need to be managed in one way or another. Follow-up can still be undertaken following the rationale of monitoring, evaluation, management, communication and governance etc. through self-regulations. Applying these principles can help with better environmental management for projects. Marsh (2004:151) encourages this approach as it can improve a developer's reputation if they are considered by stakeholders as being more environmentally responsible This shows that the rationale behind follow-up and the associated principles is not restricted only to EIA related projects but can possibly yield similar benefits for various projects.

2.6 Challenges with implementation of environmental requirements for construction phase of infrastructure projects.

The construction industry, due to its heavy resource consumption and associated negative impacts on the environment, has a major role to play in driving sustainable development. The implication of this is that the industry has to re-look at the way it conducts its activities to ensure improved levels of economic, social and environmental sustainability. The concept of sustainable construction has already been elaborated upon in the earlier sections. This ideology is based on employing measures that promote efficient ecological resource use in construction, which should be applied throughout the entire life cycle of a construction project (Lim et al., 2019:1). Therefore, sustainable construction practices should enable development that is environmentally, socially and economically sustainable.

The success of sustainable development is dependent on stakeholders in the construction industry, which are inclusive of those that Khalfan et al. (2015:941) categorises as those that are involved in the production, development, design, building, altering and maintaining of the built environment. Since the implementation of environmentally sustainable practices is heavily reliant on those involved in construction, it is imperative that better insight is gained into the challenges they experience in fulfilling these practices.

Though the research question focusses more on electricity infrastructure, the literature on sustainable construction was deemed relevant for the topic as the construction sector has common impacts. This section provides an overview of challenges to implementation of sustainable construction practices amongst construction industry stakeholders found in existing research studies. The discussion will be divided according to challenges identified in research from developed and developing countries. This categorisation was based on

views from literature which highlighted that the socio-economic differences between developed and developing countries could influence the implementation of sustainability (Du Plessis, 2002:13; Serpell et al., 2013:278).

2.6.1 Challenges to sustainable construction in developed countries

Sustainable construction was already defined in Section 2.3.2 of this chapter. The literature referred to in this section looked at research conducted in Australia and the United Kingdom. The construction industry participants that were involved included construction company practitioners, consultants, professional organisation participants, project site managers and quantity surveyors to mention but a few.

A common barrier to implementation of sustainable practices, as indicated in the responses of participants, was lack of knowledge of or understanding of sustainable construction (Wilson & Rezgui, 2013:294., Khalfan et al., 2015:943; Lim et al., 2019:7). In the study by Wilson and Rezgui (2013) participants indicated that vast amounts of information were provided but unfortunately that information was not able to be translated into knowledge that they could implement. This involved not understanding the rationale behind implementing methods to be integrated into their own work role. This was a key point, as it showed that increased awareness is not always a determining factor for understanding or successful application.

Another challenge that was raised related to the high costs of implementing sustainable practices (Khalfan et al.,2015:943; Lim et al., 2019:7). This was referred to in relation to using technologies and materials that were considered more environmentally friendly or more sustainable. Participants expressed concerns about incorporating this into their services, which meant that the financial investment requirements would escalate. This point possibly relates to another barrier around lack of demand or buy-in from clients that discouraged the integration of sustainable practices (Wilson & Rezgui, 2013; 294; Lim et al., 2019:7). If the clients whom the construction companies service have little interest in the sustainable practices, then the chances of adopting them into business practices may be financially non-viable. Participants were also sceptical about whether long-term cost savings were possible, in light of the high costs associated with implementing sustainable technologies, as indicated by participants in the study conducted by Lim et al. (2019:7).

The issue of financial implications was also raised by Khalfan et al. (2015:943) but in specific reference to lack of government incentives to implement sustainable practices. This speaks to enabling policies that support sustainable development. Due to the implication on business processes and financial impacts, governments would need to be

involved through various approaches in promoting sustainable development in their national and local contexts. Similarly, the issue of lack of legislation that would provide the legal impetus was highlighted as another barrier related to gaps in government support and categorised as an institutional barrier in the one Australia case by Lim et al. (2019:7).

Developed countries are generally expected to be better positioned to drive sustainability due to their stronger economic and social standing (Du Plessis, 2002). However, the socio-economic factors may not always be a guarantee of successful implementation of sound environmental practices as can be seen in the above discussion.

2.6.2 Challenges to sustainable construction in developing countries

Developing countries are faced with a myriad of challenges, inclusive of rampant poverty, which cascades into inefficiencies in service delivery of basic services related to water, sanitation, energy provisions and health infrastructure, to mention but a few (Du Plessis, 2002) As a result, environmental protection may not be a top priority for such countries, due to the other socio-economic priorities (Serpell et al., 2013:278). The situations in developing countries however do vary on the basis of skills levels, financial and political stability and cultures, to mention a few factors.

The literature referred to was mostly from research conducted in African countries, with the exception of studies conducted in Chile, Oman and Vietnam.

Through review of literature from developing countries outside of Africa, there were a number of challenges that were highlighted. The ones that will be focussed on are the top three (3) as presented in the various cases. One of the common challenges cited by the participants across the Chile, Oman and Vietnam studies was the lack of government incentives to support sustainable construction (Pham et al., 2020:2990; Saleh & Alalouch, 2015:190). In the case of the study from Chile, the issue of government support was interpreted on the basis that environmental sustainability was being treated as a lesser priority to the economic needs of the country (Serpell et al., 2013:283). Economic challenges were also specifically referenced in the Oman case (Saleh & Alalouch, 2015:191). Focus for government funding on environmental matters may be less of a concern versus provision of basic needs such as food, shelter health, which have a direct impact on the everyday quality of life of people. The issue of government support is however not unique to developing countries, as we saw in the previous section where similar concerns were raised. Governments play a major role in establishing an enabling environment for sustainable practices.

This can also be enhanced through ways such as shaping policies and laws which encourage industry stakeholders to adjust their working principles, not just through financial inputs.

Human behaviour factors of people resisting change from traditional methods of construction was common in the Oman and Vietnam cases but not indicated in the Chile research. Adaptation management is key in sustainable development, environmental, social and economic conditions keep changing (Du Plessis, 2002:21-22) and inability to adjust can be an obstacle. The issue of the increased costs of implementing sustainable practice was also indicated in the Oman and Vietnam cases and also featured as a challenge related to affordability in the Chilean studies. Pham et al. (2020:2991) in the Vietnam case attributed the overall low implementation rates to the resource intense efforts and extensive time that would need to be undertaken to change to practices. As a result, contractors would therefore be reluctant. Lack of awareness on sustainability was also challenge raised in both the Oman and Vietnam studies, though it less prevalent in the Vietnam study (Pham et al.,2020:2990).

The research from the African countries looked at cases from Nigeria, Ghana and South Africa. The two challenges that were common in all four African studies, though worded differently sometimes, related to lack of knowledge and awareness on sustainability matters, as well as concerns about the additional costs to implement sustainable practices (Djokoto et al., 2014:139; Okoye et al., 2021:8; Aigbavboa et al., 2017;3008; Amatapey et al.,2015:1685). The issue of additional costs cuts across both developed and developing countries as construction can be a costly exercise as is. The consideration to make financial commitments for technologies and associated training to meet sustainability standards can dim the appeal of sustainable construction for contractors (Aigbavboa, 2017:3009). Lack of government support was another, though the South African study did not list it as one of the findings and it was only highlighted in the Nigeria and Ghana cases. The reasons for the absence of this challenge in the South African case could possibly be a result of the differences in the priorities of the different countries or the structure of their environmental policies. It was interesting to note that the Ghana and Nigeria challenges related to lack of laws, regulation or enabling strategies featured, but this was not the case in South Africa. Relating this to the absence of concerns around government support in the South African study, the assumption is made that South Africa's generally well-established environmental legislative frameworks may provide a better enabling environment for sustainability. This is in comparison with the other countries referred to, where the legislative environment may probably not be as developed.

2.6.3 Comparing challenges in developing and developed countries

Based on the literature reviewed and discussions above, the overall observations in comparing the cases from developed and developing countries:

- The themes of lack of knowledge and awareness and the perceived increase of financial costs to fulfil sustainability requirements were dominant for both developing and developed nations.
- Another prevalent challenge, though not appearing in all the cases, was the need for government support through means such policies and incentives that enabled the transition to sustainable construction practices. Strong government intervention that promotes environmental agendas play a vital role. This is supported by Pham et al. (2020:2991) who argue that the enforcement of government policies for the construction industry is a key determinant of ensuring sustainable construction is realised.

Overall, with the points raised, there were more similarities in the challenges within the literature reviewed than they were stark differences.

Marsh et al. (2020) conducted a broad literature review looking at challenges to implementing sustainable practices in construction. In the research, a review of 30 articles based on research from various countries were conducted. In the results, an overview of the challenges found were consolidated into 20 subcategories and 5 broad themes as per Table 2. The challenges highlighted in blue in the table are those that were cited 15 or more times across the 30 reviewed articles. These would therefore constitute the prevalent challenges from the literature on the basis that they were found in more than half of the literature covered in the work of Marsh et al. (2020).

Table 2: Summary of challenges from reviewed literature as adapted from Marsh et al. (2020:30-31)

Themes	Sub-theme categories	Frequency of Citations
Socio-cultural barriers	Lack of knowledge	17
	Lack of understanding	10
	Lack of awareness	16
	Lack of training and education	11
	Perceived increased costs	13
	Lack of interest	9
Economic Barriers	Long payback periods	16
	Increased costs of sustainable materialds and products	10
	Implementation is time-consuming; causes delays	10
	Investment risk of new sustainable materials & methods	12
	Lack of client demand	13
Stakeholder barriers	Lack of professional knowledge and expertise	14
	Resistance to changing traditional construction processes	17
	Lack of integrated work environment and communication among all stakeholders	8
Political barriers	Lack of building codes and regulations	17
	Lack of monitoring and enforcement through building codes and regulations	12
	Lack of government support and incentives	17
Technological Barriers	Lack of adequate green technological specifications	9
	Limited availability of green product suppliers, materials and technologies	17
	Lack of databases and information for green technologies	11

The existing literature indicates there are indeed challenges associated with implementing requirements that are aimed at improving sustainable practices. The construction industry, being associated with high levels of negative impacts to the environment, needs to be one of the front-runners in driving change towards environmentally sustainable actions. Therefore, learning more about and working on addressing these challenges that may be a hindrance to such goals could add value to improving implementation.

2.7 Chapter summary

This chapter provided an overview of the literature considered as relevant to address the research question. The content included a discussion on the relationship between the construction industry and sustainable development. This was followed by defining what sustainable construction refers to and how it related to this study. Since one of the key concepts in the research question referred to environmental requirements, an overview was provided of the common requirements applicable to the construction of electricity infrastructure. Since the research touches on the implementation phase, the relevance of post-decision follow-up practices to this study was touched upon. The chapter concluded with a review of similar studies that were done where barriers to implementing sustainable construction were outlined in existing literature.

CHAPTER 3 METHODOLOGY

3.1 Introduction

This chapter outlines the research methods used in this study. The first section describes the methods applied to source relevant literature. This is followed by a brief overview of the common research designs and comparisons between them. The qualitative research design that was applied together with the associated data collection and analysis methods are then elaborated upon, followed by the ethical considerations. The chapter concludes with the methodological assumptions, limitations and a summary of the chapter.

3.2 Literature review methodology

One of the important processes in the research process is to review literature on the study topic (Boejie, 2010:21; Hennink et al., 2011:32; Cresswell & Cresswell, 2018:23; Cresswell & Poth, 2018:15). The rationale and associated benefits behind undertaking a literature study have already been alluded to in Chapter 2. The focus of this section in Chapter 3 is to summarise what type of literature was used for this study and how it was sourced.

A literature review was conducted to understand what the challenges experienced were in implementing environmental requirements for the construction of infrastructure projects. The focus on challenges was from the perspective of project team members that were not environmental personnel. Since the research topic was associated with sustainable construction, which was defined in Chapter 2, the key literature reviewed also included relevant material around this concept.

The search for applicable material was conducted by using key concepts related to the problem statement and including variations and combination of the these which included:

- Challenges/barriers/obstacles
- Environmental compliance/environmental conformance/environmental performance
- Infrastructure
- Electricity Power lines/transmission lines

- Construction
- Sustainable construction
- Project team/construction workers/project managers
- Perspectives

The search was conducted using online databases which included Google Scholar, EBSCOhost, ScienceDirect, Jstor, Scopus , Emerald Insight, the University of Pretoria consolidated legislation website, government websites as well as conducting google searches on relevant policies. The NWU Library was also visited to search for books. Past dissertations deemed relevant for the topic were also consulted and sourced from the library's online repository called Boloka. The types of material used included academic journal articles, books, previous dissertations, enacted legislative frameworks, policies and international agreements.

3.3 Research design

A research design, according to Cresswell and Cresswell (2018:3) and Cresswell and Poth (2018:49) refers to the plan on how a study will be conducted. There are three widely used types of research designs that exist within the research approaches namely quantitative, qualitative and mixed methods. The specific research approach and associated research design will guide, amongst other things, how data is collected and analysed and how results are reported. There is a wealth of published work on the intricacies of the types of research approaches, designs and related methods which goes beyond the purpose of this chapter. In this section, the idea is to provide a general overview of the common research designs within the approaches and what they entail, before focussing on the one used in this study.

A quantitative research approach is often associated with being more objective driven, using numbers, involving comparison of variables and related to statistical analysis (Guest et al., 2012:6; Cresswell & Cresswell, 2018:4; Cresswell and Poth, 2018:47; Hennink et al.,2011:16). The aforementioned authors, including Boejie (2010:11), deem qualitative research as being more subjective and considered more flexible by focussing on how people understand or interpret situations. Based on the aforementioned definitions, it does appear as if these approaches are polar opposites. Cresswell and Cresswell (2018:3) however dispute this notion and consider research approaches to exist on a continuum where a research study can either be more quantitative or qualitative instead of falling distinctly on either edge.

Guest et al. (2012:5) speaking on the same point, highlights that just because there may be characteristics commonly associated with a particular approach does not mean that those do not also exist in another. Therefore, there may be areas where qualitative- and quantitative approaches are similar. Using the continuum analogy referred to, mixed-method approaches would exist somewhere in the middle by taking advantage of the strengths of both quantitative and qualitative approaches (Cresswell & Cresswell, 2018:19).

Table 3 provides a summary of the comparison of some of the common features of the above-mentioned research approaches as summarised from literature. As previously mentioned, the characteristics outlined in the table only represent those commonly associated with the three approaches and does not imply that some may not overlap.

Table 3: Comparison of research approaches (Cresswell & Cresswell, 2018; Cresswell & Poth,2018; Hennink et al.,2011:16)

	QUANTITATIVE APPROACH	QUALITATIVE APPROACH	MIXED METHODS
GENERAL CHARACTERISTICS	Testing objective theories by comparing variables	Interested in subjective interpretations and meanings of participants	Uses a combination of features from qualitative and quantitative
	Objective is to quantify data and extrapolate results	To gain understanding of behaviour, beliefs etc.	
	Tests theories through building protection against any bias	Acknowledges that researcher's background can shape interpretation of results	
	Rarely accommodates any subjectivity	Interested in subjective perspectives	
	Process usually more rigid, systematic and controlled	Allows for flexibility in the research process	
	Larger sample size; study population referred to as *respondents*;	Smaller sample size; study population called *participants*	
	Often use controlled instruments	Researcher is key instrument to collect data	
TYPE OF QUESTIONS	Instrument based questions	Mostly open-ended	Both open-ended and closed-ended questions
TYPE OF DATA	Primarily numerical data	Interview data; observation data; document data and audio-visual data	Multiple forms of data
DATA ANALYSIS METHOD	Statistical Analysis	Text and image analysis; interpretive	Statistical and text analysis
INTERPRETATION METHOD	Statistical interpretation	Themes and pattern interpretation	Various forms

The choice of the most appropriate research design for a study is based on what will best assist in answering the research question and address the problem statement. Having gone through the characteristics of the options of research designs available, the section that follows provides more detail on the qualitative design as the selected approach for this study.

3.3.1 Qualitative research design

The research topic for this study refers to: Challenges in implementing environmental requirements for construction of electricity infrastructure: Perspectives of non-environmental project team members.

The main research question to be answered is therefore: What are the challenges experienced by non-environmental project team members in implementing environmental requirements for construction of electricity infrastructure? The key to answering this question was engaging the relevant project team members to get insights into their experiences and perspectives on related implementation challenges.

Having reviewed the characteristics of the research designs, the one whose objectives and rationale were better suited to address the research question was the qualitative approach. One of the defining features of this design is that it promotes the understanding of a situation from the point of view of the participants involved. This is facilitated through creating a platform for them to express their views, opinions, experiences or perspectives about a particular issue (Cresswell & Poth, 2018:45; Cresswell & Creswell, 2018:4; Hennink et al., 2011:10; Boejie, 2010:32). This is one of the strengths of the qualitative approach. In this way, the researcher was able to learn and interpret the challenges through listening to the lived experiences and personal accounts of the project team members involved in the construction of electricity infrastructure. This could otherwise not have been achieved through a quantitative design, whose core objective centres around quantifying or measuring variables related to a research problem. The quantitative approach does not generally aim to understand subjective perspectives or allow for open expression of perspectives. Rather, this approach leans more towards testing situations objectively, assigning numerical values and identifying statistical trends or correlations between variables (Hennink et al., 2011:16; Cresswell & Cresswell, 2018:4; Guest et al., 2012:6).

The decision to adopt the qualitative design was also influenced by reviewing previous research on similar research topics. The following are examples from the literature where

a qualitative approach was used to explore the perspectives of stakeholders on implementation of environmental requirements in construction phases:

- Amatepey et al. (2015) engaged various contractors, consultants and engineers in Ghana through qualitative interviews on barriers to successful implementation of sustainable construction in Ghana.
- Wilson and Rezgui (2013) incorporated semi-structured interviews to explore barriers to sustainable construction among construction industry stakeholders in the United Kingdom.
- Saleh and Alalouch (2015) undertook qualitative observations in Oman to explore challenges in sustainable practices in construction industry.
- Bennet et al. (2016) looked at stakeholder perceptions of Environmental Management Plans in the United Kingdom using semi-structured interviews.

The outcomes from the application of qualitative methods in the above literature were able to provide evidence of the suitability of this research design in addressing the research problem for this study.

3.4 Data collection

Data collection, according to Cresswell & Poth (2018:147) refers to more than the specific action of going into the field and gathering information. Instead, it is made up of an integrated series of activities that influence the actual data gathering. These seven activities involve identifying places or people to study, accessing the site or engaging potential participants, selecting a sample, actual collection of data, recording data, managing field issues and data storage (Cresswell & Poth, 2018:147-148). Given the restrictions in the scope of this methodology section, focus will only be on describing the sample selection and data collection methods that were used.

3.4.1 Sample selection

The selection of participants to take part in a study in qualitative research is based on the concept of “purposeful sampling” (Cresswell & Cresswell, 2018:185; Cresswell & Poth, 2018:148; Boejie,2010:35; Guest et al., 2012:249 and Hennink et al., 2011:85) also refers to this as “purposive sampling”.

This basically refers to deliberately identifying and selecting individuals or sites that can best provide the necessary information to address the research problem. The criteria that can be used to identify such individuals would typically be those that have the knowledge

and experience in the field or activities that are the focus of the study. In the case of this particular research, the key selection criteria were based on individuals who are not environmental professionals, are involved in the construction of electricity power lines and who have some responsibility in implementing environmental requirements. The individuals selected had to meet all three aspects of the criteria to qualify.

Based on the researcher's experience in electricity infrastructure construction projects, individuals working in the following roles were identified as meeting the sample selection criteria:

Line design engineers -They have to incorporate conditions from environmental legislated permits, specialist reports and EMPs into powerline designs. Serpell et al. (2013:278) considers designers as playing an important role by carrying out sustainability goals through technical drawings to be implemented during construction.

Civil engineers – They have to design and guide earthwork activities, inclusive of stormwater drainage, taking into consideration environmental sensitive features in the area and aligning with environmental permit conditions

Construction supervisors- They oversee work on behalf of the owner of the project to ensure that construction contractors build according to agreed design and follow environmental guidelines, and check work quality.

Project Managers: Ensure the project runs within time, scope, budget and within agreed quality.

Construction workers- They conduct the physical work and are expected to do so in line with the conditions from environmental permits or documents drawn up to guide mitigation of environmental impacts.

In terms of sample size, Hennink et al. (2011:17) recommends involving fewer participants, on the basis of intently aiming for more in-depth or richer information from a smaller group versus a larger group. The rationale does make sense, as having more participants would require more time and can result in data collection being rushed in attempt to cover the entire sample.

The targeted sample size of twenty-five (25) participants was used but ended with twenty-four (24) participants who took part in this study. The rationale behind the targeted sample of 25 was primarily informed by the guidance of the research supervisor. It was also considered an achievable sample size given the time allocated for data collection in the academic programme. This included taking into consideration how accessible potential participants were at the time.

The number of participants per project role who took part in the study is outlined in table 4.

Table 4: Number of participants per role

Participants' Project Role	Number of participants
Construction managers	6
Construction supervisors	5
Engineers	4
Project Managers	4
Safety Officers	3
General workers	2

The participants involved were from four (4) different construction companies as well as some who worked for developers in the electricity infrastructure industry.

Participants were approached to be involved in the study through various means, such as face-to-face interactions, telephonic discussions, Microsoft Teams calls and email. In inviting them to be part of the study, the researcher provided an information document which introduced the researcher, outlined the purpose of the research and reasons why they were selected as potential participants. A copy of the research information document is included in Annexure A.

3.4.2 Interview method

The data collection method used in this study was semi-structured in-depth interviews. This method was considered as best suited for the research question. Through being more conversational and flexible, it better facilitates gathering in-depth perspectives of participants to better understand experiences and thoughts that can influence behaviours and attitudes. (Roller & Lavrakas, 2015:51; Galetta, 2013:47; Hennink et al., 2011:109; Rubin & Rubin, 2012:29; Cresswell & Cresswell, 2018:187). Interviews are also useful in engaging directly with participants and gives them an opportunity to voice their perspectives on a particular issue. Table 5 outlines a few strengths and weaknesses associated with the interview method.

Table 5: In-depth interview strengths and weaknesses (Roller & Lavrakas 2015:56-57; Hennink et al.,2011:131; Cresswell & Cresswell, 2018:188)

STRENGTHS	WEAKNESSES
Enables getting in-depth account of people's experiences, thoughts, ideas etc.	Interpretation of data can be influenced by interviewer's personal values, beliefs, presumptions, knowledge, experience etc.
Allows for flexibility to tailor question wording or order in line with the flow of the interview	Power dynamics between interviewer and interviewee can negatively affect interview environment and accuracy of data
Enables researcher control over interview process and line of question	Transcription can be lengthy and time consuming
Affords opportunity to hear experiences, perspectives, accounts directly from people	Can disadvantage interviewees who may not be as articulate or able to express themselves in detail verbally, thereby limiting data content.

Semi-structured interviews often comprise of both open-ended questions and structured questions (Galetta, 2013:45). Having open-ended questions afforded the opportunity for participants to elaborate and express their perspectives on the research problem in a more detailed manner (Bernard & Ryan, 2010:34; Cresswell & Cresswell, 2018:187; Cresswell & Poth, 2018:52). This was imperative for the study as the researcher was interested in learning more about the challenges in the construction phase, specifically from the viewpoint and experiences of the participants. This would otherwise not have been possible with questions that only required yes and no answers that would not have provided details from a participant's personal perspective. Semi-structured interviews also

allow for inclusion of structured questions which help to accommodate aspects that the participants may have not touched on in the open-ended questions (Gillham, 2005:70; Galetta, 2013:45).

Fourteen (14) interviews were undertaken through face-to-face interaction. There were cases where it was not practical to physically meet with participants due to geographical location and schedule differences. In such cases, interviews were conducted through other means such as Microsoft Teams calls as an online platform, nine (9) interviews were conducted via this platform. One (1) interview was conducted telephonically.

The sessions were recorded via audio recording devices inclusive of the researcher's cellphone voice recorder and the Microsoft Teams recording function. These recordings were then transferred to a file on the laptop. All recordings were taken with the permission of the participants.

3.4.3 Interview guide development

The interview guide or interview protocol is a document with the questions to be asked and is used by the researcher to guide the direction of the interview (Hennink et al., 2011:112; Cresswell & Poth, 2018:149; Cresswell & Cresswell, 2018:190; Roller & Lavrakas, 2015:80). This document serves as an aide to the interviewer during the session and as a point of reference to ensure that all questions are addressed with each participant. Another feature of semi-structured interviews is that they accommodate flexibility in the questions. The questions are therefore not static and could be adjusted through ways such as probing questions or changing wording in order to address points that came up during the interview (Roller & Lavrakas, 2015:53; Bernard & Ryan, 2010:29).

The questions were divided into sections A and B. The first section comprised open-ended questions that gave the participant the opportunity to express their perspectives more broadly. These were five (5) basic questions that were aimed at determining the role of the participant in construction, their level of awareness on environmental requirements and the challenges experienced in implementing them. As a closing question to the interview segment, participants were asked for recommendations to address the challenges. The full interview guide that was used is included as Annexure B and the questions from section A are copied below for ease of reference:

***Opening question**:*

a) Kindly explain your role/involvement in construction of electricity infrastructure projects

Core questions

<u>Section A</u>

1. *To what extent are you aware of the environmental requirements related to your job/role?*

2. *What are the challenges you experience in implementing the environmental requirements in undertaking your work?*

3. *Why are those requirements challenging to implement?*

4. *What do you think can be done to resolve/address those challenges?*

Section B included questions which Galetta (2013:45) refers to as “theoretically driven”, which were based on the challenges to implementation of environmental requirements as derived from papers reviewed in the existing literature. This was apart from one (1) question which was included on the basis of anecdotal evidence from the researcher’s experience in construction projects. This particular question related to impracticality of requirements. The number of questions or challenges that were included in this section were nine (9) in total. These were presented on a Likert scale format where participants had to indicate to what extent they agreed or disagreed that those points listed were challenges, based on their experience or perception. According to Joshi et al. (2015:397) a Likert scale is used to measure attitude or perspective of participants around a particular issue.

The Likert-type scale used was on a 5-point scale where choice of answers ranged from the extremes of strongly agree to strongly disagree and a neutral position of uncertainty located in the middle. Part of the purpose of this set of questions was to supplement the open-ended ones and to further provoke the participants' thinking around possible challenges. Even when addressing the Likert scale-based questions, participants were provided with the opportunity to elaborate on the reasons for their responses, thus triggering further in-depth details and experiences to be shared. The questions that formed part of section B are copied below:

Section B

Please rate on a scale from 1-5 to what extent do you agree or disagree that these are challenges that you have experienced in implementing environmental requirements for construction of electricity infrastructure?

The points on the scale refers to the following response:

1= Strongly agree

2= Agree

3= Uncertain

4= Disagree

5- Strongly Disagree

Kindly rate/indicate your level of agreement for each statement and elaborate verbally on your choice of rating.

***Question**:*

To what extent do you agree or disagree that these are challenges that you have experienced in implementing environmental requirements for construction of electricity infrastructure?

a) *Lack of knowledge/awareness/education on environmental requirements*
b) *Concern of increased costs associated with implementing environmental requirements*
c) *Implementation causes delays to project progress*
d) *Requirements are impractical to implement*
e) *Stakeholders are not engaged or integrated in the earlier phases where requirements are determined*
f) *Lack of incentives to implement environmental requirements*
g) *Don't understand the benefit or value of following/implementing environmental requirements*
h) *Other requirements take priority over environmental management requirements in projects*
i) *Lack of support/resources to effectively implement requirements*

The interview guide was first piloted or tested by asking two (2) other people who were not part of the sample, but met the similar selection criterion as the participants, to have a look at the interview questions. Some of the reasons for piloting are to ensure that questions are understandable; that the language used can be easily interpreted, that jargon is limited and whether the sequence of questions is logical (Hennink et al., 2011:120). There were no comments from the piloting that required the questions to be amended as the two (2) individuals indicated that they were understandable. A copy of the full interview guide is included as Annexure B.

3.5 Data analysis

Boejie (2010:76) refers to data analysis as involving breaking apart the data into manageable parts in order to derive meanings or patterns from them with the intent to present them into explainable findings. The type of data that is produced from interviews is textual data, primarily in the form of transcriptions, where the interview discussion is written out. Transcription of interview data is therefore considered by Hennink et al. (2011:211) as the first step in preparing for analysis.

The audio recording of each interview was listened to by the researcher, and a summary of the responses per question was typed out on a Microsoft Excel spreadsheet. Each tab in the spreadsheet represented the interview results of an individual participant. On each tab, the questions from the interview guide were typed out in one column and the associated responses were transferred into the adjoining column to the question. Where there were specific quotations or statements made by the participant, which captured or alluded to a specific challenge to implementation, then these were typed out verbatim in the next column. The populated spreadsheet therefore became the basis for further analysis.

The analysis methods that were used for this study was content analysis for the interview text data and calculating of percentages for the Likert scale-based questions. According to Hsieh and Shannon (2005:1278), content analysis involves interpreting text data to derive meaning by assigning codes from which patterns are identified, which in turn can be categorised into broader themes. The generating of codes involves reading through text interview data and then categorising the data according to specific ideas, topics or themes (Boejie, 2010:95; Hennink et al., 2011:216; Cresswell & Cresswell, 2018:194; Cresswell & Poth, 2018:10). When analysing the data, segments of the data often relate to particular ideas, subjects or topics. Therefore, the codes that would be assigned to each segment would essentially serve as a description or *"*label*"* summarising what a particular piece of text is about (Boejie, 2010:95-97; Hennink et al.,

2011:224). In as much as a code describes what a segment of data is about, the naming of a code must be determined according to its relevance to the research question (Saldanha, 2013:4). In the case of this study the research question focussed on determining what the challenges were in implementing environmental requirements. Therefore, when the researcher was undertaking the coding process, attention was paid to instances in the data where participants referred to or alluded to a particular challenge.

The codes that were assigned were then a summary of the challenge, as interpreted from the interview text. Interpretative coding was used which involved, not focussing only what was said exactly but what Boejie (2010:104) referred to as “discerning the meaning” of what was expressed by the participant.

After codes were identified throughout the text, these were compared with each other to see which related to similar ideas or concepts and formed patterns. The patterns were identified on the basis of which similar codes or concepts were found to be repeated throughout the data by various participants. This is what Saldanha (2013:6) refers to as “repetitive patterns of action and consistencies”. These patterns were considered as first-level categories and are listed in Figure 11. These were then allocated into broader categories called themes, which, according to Cresswell and Poth (2018:194) and Guest et al. (2012:67), comprise of different codes that speak to a common idea or concept related to the research question. The identification of themes in the case of this study was reliant primarily on emerging themes from text data and not pre-determined themes. The prevalence of each challenge category or pattern was determined by going through the interview data in the spreadsheet and counting how many participants cited or referred to that particular challenge. In instances where a participant made more than one statement that was classified under one theme, that statement was only counted once as it was from the same participant. The results of the prevalence or frequency of this data is presented as a bar graph in Figure 12.

The second aspect of the data analysis focussed on the Likert scale-based questions. This involved calculating the percentage of participant response per variable. For example, if the question asked to what extent was lack of environmental awareness was a challenge in construction, then analysis involved calculating what percentage of all the participants agreed, strongly agreed, disagreed etc. These percentages were then presented in the form of a graph, presented in Figure 13. The participants had an opportunity to elaborate on their rating choice and those substantiating responses formed part of the text data that underwent content analysis.

3.6 Ethical considerations

The research proposal was reviewed and approved by the Faculty of Natural and Agricultural Sciences' ethics committee with the research assessed as being of minimal risk in terms of ethical considerations. Ethical clearance was therefore obtained with ethics number NWU-01225-22-A9 issued.

Additional key ethical issues related to this study included matters related to protection of privacy and consent. In order to address these, the anonymity of participants was ensured by not including their names on the reports but rather assigning numerical references to them e.g. participant 1. The participants were also informed at the beginning of the interviews that their identities would be protected in such a manner. On the issue of consent, all participants were provided with an explanation of what the research was about when inviting them to participate. This was accompanied by a consent form that had to be signed by participants before commencement of interview as proof of consent to take part in the study. All participants have signed the consent forms and a copy of this template is included as Annexure C.

3.7 Methodological assumptions and limitations

One of the common assumptions related to the interview method is that all participants were truthful in the responses they provide and therefore the results presented accurate perspectives. It was not simple to prove this, as the researcher had to rely on the integrity and good faith of the participants. However, ways to encourage honesty included explaining in as much detail as possible the reasons for the study, so that the motive behind asking questions were clear.

Limitations are considered as flaws or "weaknesses" in the research that are identified and presented by the researcher (Cresswell & Cresswell, 2017:199) and that may have contributed to the outcomes of the research. The study included participants who were colleagues of the researcher. This scenario is what Glesne and Peshkin, 1992 cited by Cresswell and Cresswell (2018:184) refers to as "backyard research", where research takes place with people familiar with the researcher. This aspect can be beneficial by creating a more relaxed environment for interviews due to already established relationships between researcher and participant. Secondly, setting up interviews were more convenient due to easier access to potential participants. However, the potential also existed that participants may mask honest answers in an effort to protect the relationship with the researcher or avoid sensitive topics related to work policies (Cresswell & Cresswell, 2018:184). One of the ways to encourage openness and honest response from participants was asking participants to be as honest as possible, so that learning can be achieved through their experiences. In addition, assurance was provided in the consent form that

no aspect of the findings of the research will be negatively used against them in either the work environment or in any inter-personal interaction with the researcher. This strategy was emphasised by the written commitment in the consent form that anonymity of participants will be protected so that there is no correlation to the real identities of the individuals involved. Based on the outcomes of the interviews and interactions, the potential limitations highlighted did not materialise, as it was perceived that the relevant participants who were colleagues were truthful in their responses.

Another limitation related to the use of the five (5) point Likert scale. Based on the manner of responses to section B of the questions, participants drifted more towards plain agree and disagree, and seemed to be a reluctant to express a stronger view on either side of the scale. Some of the reasons for this cited by some participants were that strongly agreeing or strongly disagreeing was interpreted as not accommodating instances where such a challenge may not be relevant. They therefore felt it was safer to err on the side of caution and opt for a less emphatic stance. Secondly, participants did not always clearly express agreement or disagreement. This was overcome by interpreting their stance from the details or examples indicated in their responses.

Challenges regarding language preferences between the researcher and the participants were also experienced. The interview guide and interviews were primarily planned for and conducted in English. However, there were three (3) participants who were more comfortable to communicate in Sesotho. Fortunately, the researcher was fairly fluent in this language and in planning for the interviews with the three (3) individuals, the questions were first translated into Sesotho to facilitate better communication. The responses from these interviews had to be first translated into English before they could be prepared for analysis.

The question relating to the challenge of increased costs from section B of the interview guide did not accommodate participants who were not involved in the financial aspects of the projects, such as the general construction workers. As a result, the responses to this question by these participants were indicated as uncertain by the researcher.

3.8 Chapter summary

This chapter provided an overview of the research methodology employed in conducting this research. The way the literature review was conducted was explained, which included sourcing books, journal articles, past dissertations, policies and legislative frameworks through online platforms, and accessing the institutional library. This was followed by providing a comparison of the common research designs that were taken into consideration before selecting the best-suited

approach. After considering the options, the decision was taken to employ a qualitative design and the reasons behind its suitability were therefore provided. The details behind the data collection process followed, inclusive of the sample selection process, and the interview methods were then elaborated on. A discussion of the data analysis procedures employed were outlined. The chapter concluded with a brief discussion on the ethical considerations plus the assumptions and limitations associated with the study.

CHAPTER 4 RESULTS AND DISCUSSION

4.1 Introduction

In this chapter the results from the interviews conducted as per the methodology described in Chapter 2 are presented.

The results are arranged according to the sections of the semi-structured interview guide where Section 4.2 summarises the results from section A of the interview guide (open-ended questions) and Section 4.3 focusses on those from section B (structured, Likert scale-based questions). Section 4.4 follows where the results will be interpreted and discussed on the basis of, amongst other things, their relationship to existing literature. The chapter concludes with a summary on the important points highlighted and noted from the discussions.

4.2 Results related to section A of the interview guide: Open-ended Questions

Each of the twenty-four (24) participants were asked similar questions with, variations being applied where probing for more insight or elaboration on a response was required. The questions in section A were formulated in an open-ended manner to allow the interviewed individuals to freely express their perspectives and experiences.

The opening question focussed on introducing the participant to the researcher, with the aim of understanding the role that each participant fulfilled in the construction of electricity infrastructure. The overall job profiles of the sampled participants who responded to this question were outlined in the preceding methodology chapter, Section 3.4.1, where details are provided of the participants sampled.

The second question was aimed at assessing which environmental requirements were applicable to the individual participant's role in construction, based on their experiences and perspectives. This was meant to supplement the discussion from the literature review (Section 2.4) that dealt with research objective 1 (RO1) which focussed on the common environmental requirements applicable to the construction of electricity infrastructure. The rest of the questions in section A were directed at addressing research objective 2 (RO2) and the main research question about finding out what challenges the participants had in implementing the environmental requirements relevant to their role in the construction of electricity infrastructure.

4.2.1 Results related to research objective 1 (RO1)

Research objective 1 involved identifying the common environmental requirements associated with the construction of electricity infrastructure. This was primarily addressed in Chapter 2, being the literature review portion. During the interviews, participants were asked a question also related to RO1. This provided the participants with the opportunity to share which environmental requirements they encountered in executing their tasks for the construction phase of projects. The intention of this question was not to derive a comprehensive list of every applicable requirement, but rather to broadly gauge the extent of awareness and experience they had with environmental requirements.

The participants' responses to this question revealed that they are generally familiar with the requirements applicable to their role, even though some did not necessarily make specific references to a name of a document or environmental management tool. Instead, the majority of the participants quoted particular mitigation measures or stipulated conditions that they often have to conform to or comply with. The researcher could, due to experience and familiarity with some of the examples given, make a connection to the typical source documents of the articulated requirements.

Upon that basis, the requirements the participants alluded to and specifically mentioned were the following:

- Environmental Management Plan conditions (This was the tool or requirement most cited amongst the participants though not always explicitly referenced by name.)
- Water use authorisation conditions
- Vegetation removal permit conditions
- Environmental authorisation (EA)
- Various environmental specialist mitigation measures
- ISO 14001 requirements
- Landowner and property access rights requirements

The above examples are synonymous with those elaborated upon in Section 2.4 of the literature review chapter. This is with the exception of the requirements related to landowner or property access conditions.

4.2.2 Results related to research objective 2 (RO2)

The second research objective focussed on investigating the challenges non-environmental project team members experience in implementing environmental requirements. The participants were individually asked to share their experiences and perspectives on this topic. The responses to this question resulted in numerous viewpoints expressed which were captured in a spreadsheet per participant. The challenges derived from the participants responses were then grouped together based on similarity i.e. relating to a similar point, and therefore formed the first level of categories which were thirty-one (31) in total. These were further assigned into seven (7) broad themes, based on interpreting the common overarching topics that the initial thirty-one (31) categories related to. These themes were developed according to the method described in Chapter 3. Refer to Figure 11 showing the thirty-one (31) challenge categories arranged according to the respective themes.

The descriptions of each broad category(theme) are outlined below:

- **Environmental site support challenges*:*** This theme encapsulated the challenges associated with environmental personnel who are required to offer guidance and support to the construction teams. The concerns raised involved the infrequency of environmental professionals visiting the construction site during implementation. The issues also related to the need for these visits. The second aspect of this theme seemed almost contrary to the first, in that participants lamented the behaviour of environmental professions when they do come to site. The concerns raised in this regard related to environmental personnel being more compliance driven when on site, instead of supporting and engaging with construction teams.

- **Validity and clarity of requirements***:* The challenges categorised under this theme related directly to the concerns that participants had with the requirements themselves. This referred to, amongst other things, the way the requirements were structured. That led to misinterpretations and the perception that some requirements are not relevant to current site conditions, since they were often written a long time before the construction phase. This also included issues pertaining to practicality, effectiveness and reasonability of mitigation measures aimed at managing negative impacts.

- **Competency and capacity*:*** The frustrations associated in having to interpret and apply requirements from a field point of view, where one is not skilled or adequately knowledgeable, came across in various ways amongst the participants. This theme incorporates challenges raised that dealt with the inadequacies the participants felt and the associated factors that contribute to these.

- **Weak project integration***:* Projects are typically focussed on time, scope, cost and quality (Opuku & Ahmed, 2014:97; Martens & Carvalho, 2016:30) and some of these can take higher priority in construction projects. The challenges categorised under this theme relate to factors that contribute to environmental requirements being overlooked instead of them being interwoven into the broader project-life cycle processes.
- **Delays to construction***:* This theme addresses challenges where accommodating environmental requirements was perceived as associated with delaying completion of construction work. This theme incorporates various factors that contribute to such delays.

- **Human behaviour*:*** Implementation of requirements lies in the hands of people whose ability or effectiveness to act can be influenced by behavioural patterns. This is the basis for this theme, which incorporated various challenges pertaining to negative behaviours being cited as being possible hindrances to successful implementation of environmental requirements.

- **Institutional support*:*** In order for successful implementation to take place, there needs to be a conducive enabling institutional environment. This theme addressed issues that did not promote effective implementation of requirements but that are outside of the locus of control of implementors, such as leadership commitment and external stakeholder inefficiencies.

In addition to the development of themes, the prevalence of each challenge category was determined by counting how many of the participants referred to a particular category. The results of this can be seen in Figure 11 below, where the number on each bar of the graph represent the number of participants who highlighted that specific problem. If a participant indicated the same challenge more than once, it was only counted once for that individual. As can be seen in Figure 12, there were challenges that were distinctly more common, creating more prevalent patterns amongst the participants interviewed based on the frequency of repetition. The prevalence of a category does not necessarily imply its importance over the others. The focus of the research question was to determine what the challenges to implementation were, rather than measuring the value or importance of the

challenges. Tracing the repetitive challenges therefore simply served the purpose of highlighting the dominant ones amongst this particular sample. The categories are grouped according to the themes they belong to, which are represented by the various colours referenced in the legend below figure 11.

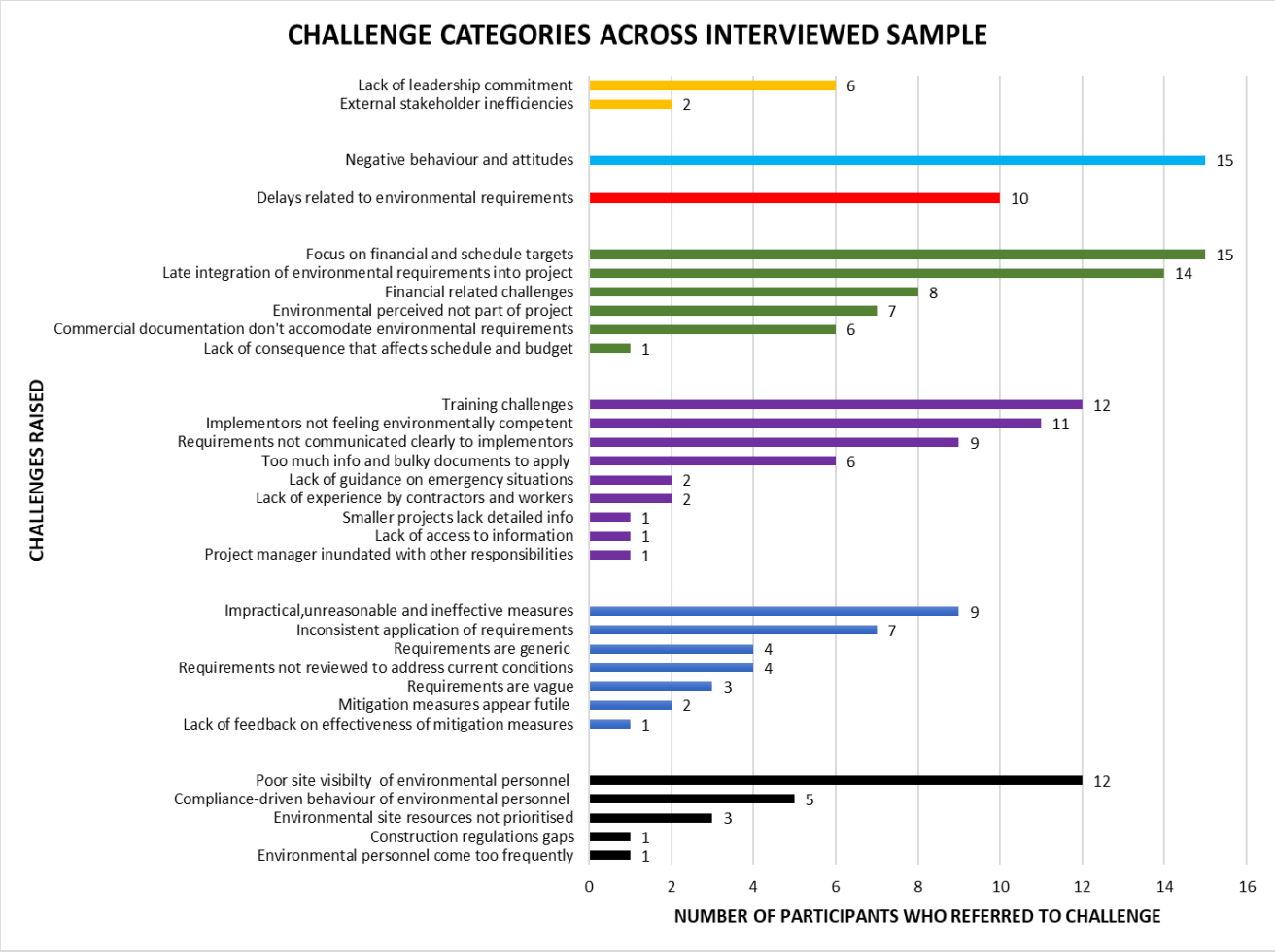

Figure 11: Challenge categories across interviewed sample

LEGEND FOR THEMES GRAPH	
Colour coding	**Theme category**
	Institutional support
	Human behaviour challenges
	Delays
	Weak project integration
	Competency and capacity theme
	Validity and clarity of requirements
	Environmental site support challenges

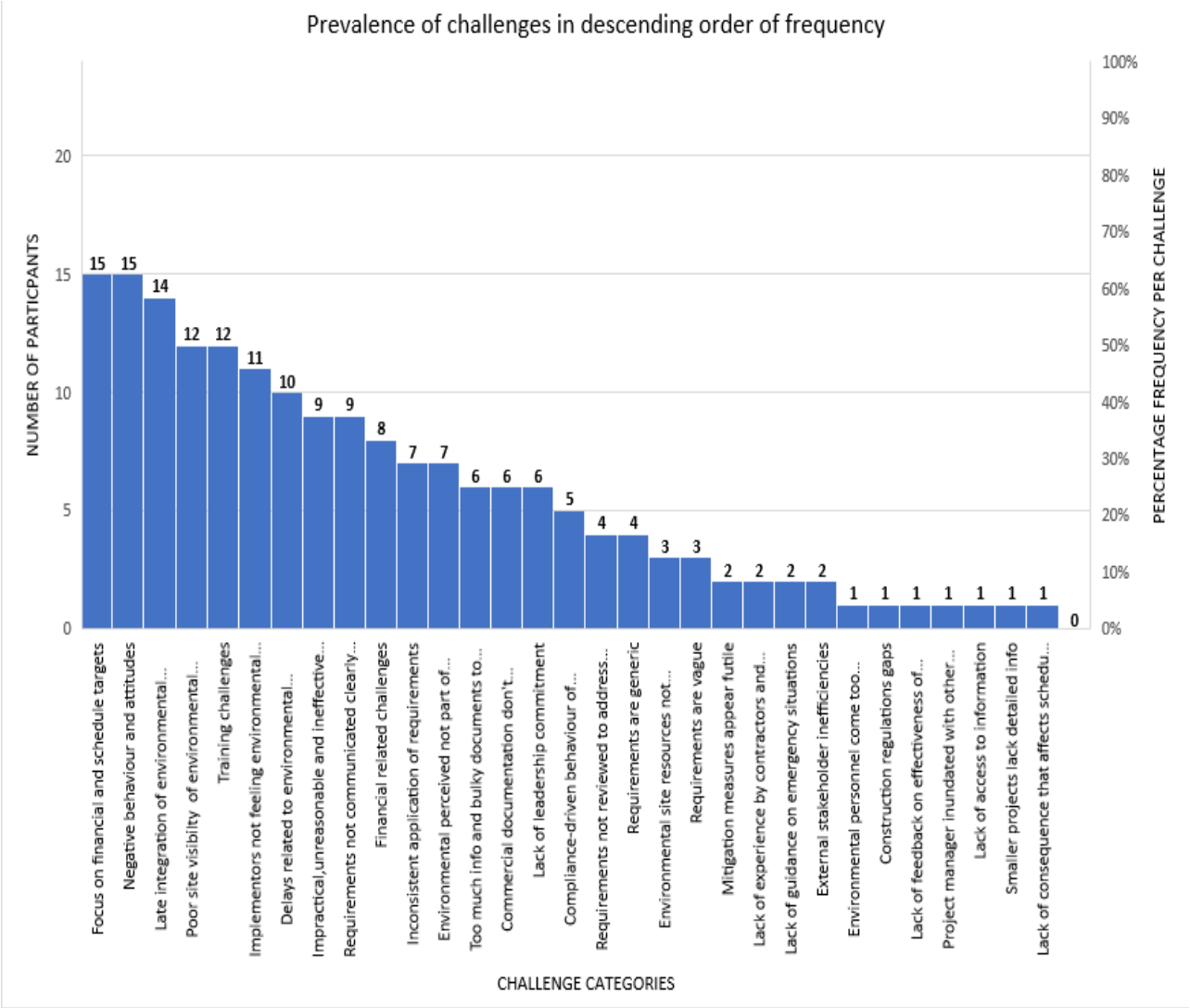

Figure 12:Prevalence of challenges according to frequency

When analysing how frequently each challenge category was highlighted, the five (5) most prominent challenges where ≥50% of participants raised the challenges are listed below:

- Negative behaviour and attitudes (63%)
- Focus on financial and schedule targets (63%)
- Late integration of environmental requirements into project (56%)
- Training challenges (50%)
- Poor site visibility of environmental personnel (50%)

4.3 Results related to section B of the interview guide: Likert scale-based questions

Section B of the semi-structured interview guide comprised of nine (9) challenges that emanated primarily from similar studies done in the literature, as well as a few challenges that were determined from anecdotal experiences of the researcher. These challenges were pre-selected based on the approach described in Section 3.4.2.1. Each participant was asked whether that specific challenge has been or is, according to their perspective or experience, a hindrance to implementing environmental requirements. The responses had to be indicated on a five (5) point scale ranging from strongly agree to strongly disagree. The summary of all the responses is indicated in Figure 13. Where there is a “0” indicated on the graph, it indicates that there were no participants who had opted for that response on the scale.

Though the 5-point scale method accommodated a stronger stance on either an agreement or disagreement, the summary of the analysis and discussion will not focus on the extent of both extremes. Rather, attention will be directed towards the percentage of agreement or disagreement, irrespective of the strength of the view along the scale. The research question centred around what the challenges to implementation are, and not so much the extent of agreement about a challenge, hence the approach to consider agreement vs disagreement. This was one of the limitations of selecting the 5-point Likert scale for this study, as was addressed in Section 3.7 of the preceding chapter.

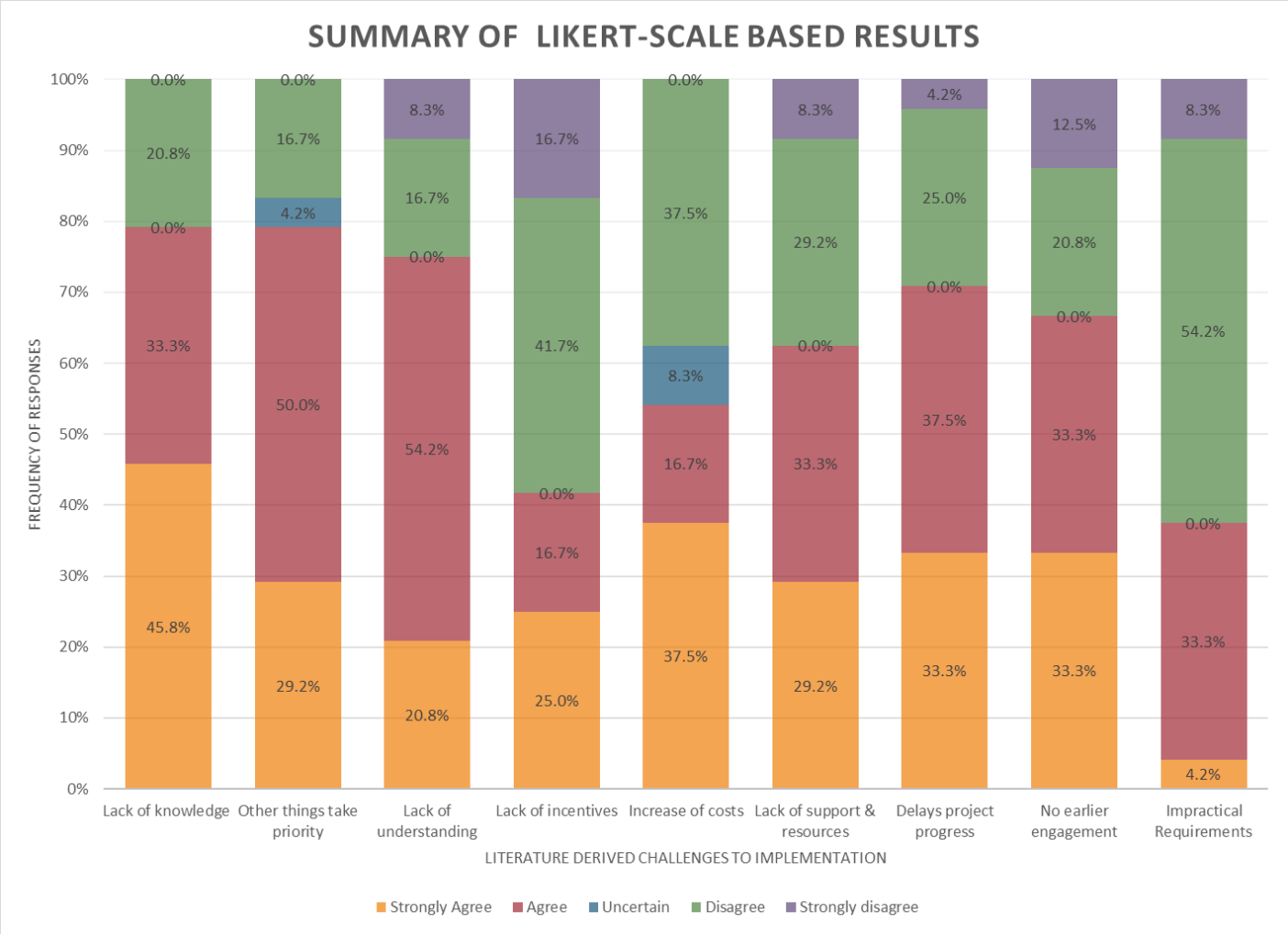

Figure 13: Summary of Likert scale-based results

The challenge categories where over 50% of the participants were in agreement are indicated in Table 6.

Table 6: Participant agreement of > or = to 50%

Challenge category	Percentage of agreement amongst participants
Lack of knowledge	79%
Other things take priority	79%
Lack of understanding	75%
Delays project progress	71%
No earlier engagement	66%
Lack of support or resources	63%
Increase of costs	54%

In contrast to the above, the categories where over 50% of the participants disagreed with those factors being a challenge to implementation of environmental requirements included:

- Impractical Requirements: 63% of participants disagreed
- Lack of incentives: 53% disagreed

The above analysis indicates that the majority of the participants resonated overall with the selected challenges from the literature, as can be seen by the higher frequency of agreement with seven (7) of the nine (9) challenges. When comparing the results of these structured questions in section B with those from section A, the more prevalent categories are similar. For instance, the challenge of “Other things taking priority” was one of the dominant categories (79%) in section A and almost consistent with the challenge category of “Focus on financial and schedule targets”, which was one of the more recurring categories. Similarly, the issue of environmental requirements being associated with delays was one of the dominant patterns in both section A and section B.

There were, however, some contradictions between this study's findings and those in the literature. An example of this was lack of incentives being considered a challenge which featured as one of the top-ranking challenges in Marsh et al. (2020:31)'s literature review where 57% of the studies reviewed highlighted this as a challenge. When asked about the relevance of this point, 53% of the participants in this study disagreed with lack of incentives being a hindrance to implementation. Some participants indicated that people should not be incentivised for doing the right thing and should rather focus on taking responsibility instead of pursuing reward. In the case of requirements being considered as impractical, 63% of participants disagreed with this being a challenge to implementation. Unlike the other questions in section B, this result could not be compared against existing literature findings as the inclusion of impracticality of requirements was not evident in the literature. Rather, this challenge was integrated as part of the interview guide based on anecdotal evidence based on the researcher's work experience. The finding was however interesting to note that the larger percentage of participants consider the requirements implementable.

4.4 Interpretation and discussion of the results

In this section the results that were presented in Section 4.3 will be interpreted and discussed, primarily by comparing them with findings from existing literature, as well as what the implications could be for successful implication. The layout of the discussion points will be categorised according to the seven (7) themes already identified and the categories within each theme. In each section the challenge categories that were most prevalent per theme will be addressed first and cascade down to the least prevalent. Even though all the categories will be highlighted, focus will be on the prominent categories per theme compared to those where fewer participants raised particular challenges.

4.4.1 Competency and capacity theme

The definition of competence, according to the Merriam Webster online dictionary, can be summarised as having the requisite knowledge, skill and ability to apply knowledge towards the fulfilment of a particular task (Merriam-Webster, Inc.,2022). Pham et al. (2020:2993) also relates competence to "on-site practical skills, personnel quality and continuing professional learning". Capacity is closely related to it, as it has to do with having the capability or the ability to do something. These concepts both have relevance to the research question, because if there are factors that affect people's ability to implement requirements then those can be a hindrance to successful implementation.

This was the rationale underlying this theme, as participants raised different challenges that related to gaps in knowledge, skill and experience that they felt they had, which hampered successful implementation.

Figure 14 below is an excerpt showing the categories within this theme.

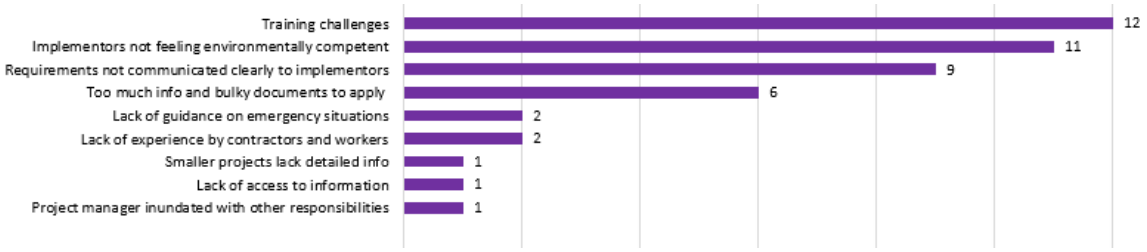

Figure 14: Challenges in competency and capacity theme

a) Training challenges

Environmental management is a specialised field of expertise and all of the participants who have some responsibility to implement requirements are not professionals in this arena. One of the ways they would therefore rely on to address the learning and exposure gap on environmental requirements would be through training. It was therefore not surprising that one the most prevalent challenges raised by 50% of the participants had to with training inefficiencies. The issues raised in this regard were numerous, but were not so much about the lack of training but rather about the effectiveness and quality of the environmental trainings. One of the sentiments that came across quite strongly in this regard related to the lack of understanding, or no adequate explanation of the reasons behind the requirements. In other words, participants were more interested in understanding the rationale behind the requirements beyond simply following them as part of compliance to legislation. A similar trend was seen in the Likert scale-based results where 75% of participants agreed that there was a lack of understanding of the environmental requirements. From the participants' responses there appeared to be a desire to understand the "why" behind having to follow certain requirements, aside from legal obligations. This stance was aptly expressed by participant 6's response who said, "If we don't have context as to why we don't do that…the training that is provided is a compliance thing, so most people don't take it seriously". In addition to that, the perspective that *"*Environmental awareness training is a list of don'ts. Then there is environmental law training which is don't do this, or else you will get arrested*"*.

Similar thoughts were echoed by participant 23 who stated *"*Don't just say the client says its rehabilitation there. You know you must not park there but you don't know why*".* The quote that was considered to best succinctly capture the issues raised about the training approach was "It's knowing but not understanding" as expressed by participant 23*.*

The concern with the poor communication of the "why" behind the environmental requirements was considered as a major challenge, as the trainings were not seen as aimed at fostering understanding and buy-in, but rather seen as driving legal compliance. As a result, participants felt that trainings are attended because they had to, but there was little internalisation of the information due to not always understanding the benefit or contribution to the environment by following the requirements. This could also be seen from the responses to the Likert scale-based questions, where 75% of the participants agreed that there was a lack of understanding of environmental requirements.

Another related challenge had to do with the frequency of the training interventions. Participants 9, 22 and 23 felt that environmental trainings are often done once at the start, and the expectation is that people will remember everything as the project progresses. This is seen as ineffective, especially if the construction period runs for a longer time, where people may forget what was said earlier before work commenced or personnel changes occur during the construction phase. In addition to this was the concern raised by participant 12 about the trainings being too theoretical. This participant noted how trainings are often classroom based and lacked field-based component to experience or observe what is being spoken about. Participant 16 highlighted issues of language and educational barriers as hampering understanding. Other challenges mentioned by 1 or 2 participants included the use of environmental jargon hampering understanding and trainings not being designed for specific job roles.

Training challenges ranked as the 3rd most prevalent challenge category overall across all the themes in this study. When comparing these results to those from the literature, concerns related to training did also feature though not as dominantly. Marsh et al. (2020) highlighted that of the thirty (30) research articles reviewed, lack of training and education was cited in eleven (11) articles and lack of understanding featured in ten (10) of the thirty (30) articles. However, looking at the context of this specific research, the description of the categories from Marsh et al. (2020) though training related, referred to the lack thereof, whereas, in the context of this study, the issues were more about the content or focus of the trainings. Lack of understanding was, according to Marsh et al. (2020:31), cited in ten (10) of the thirty (30) articles reviewed. This

particular challenge can be linked to the earlier discussion, where participants were advocating for more focus on explanations and reasons behind requirements, thereby not simply obtaining knowledge, but understanding the rationale behind that knowledge so they can be assured of why it is important to be applied beyond the focus on fulfilling legislative requirements.

Training is interlinked with knowledge, as the aim of undertaking training is to gain knowledge, with the assumption that, if people have the knowledge, they will know what to apply and should implement successfully. During the Likert scale-based interviews, 79% of the participants agreed that lack of knowledge about environmental requirements was a challenge. However, upon further elaboration by participants on their responses and from interpretation in the open-ended questions, it was not purely a lack of knowledge, but rather a lack of understanding of the knowledge received.

Wilson and Rezgui (2013:296) made a similar finding in this regard about the "lack of transference of knowledge into action", where people may not understand the reasons behind having to apply that knowledge and therefore end up not applying it. As was the case in this research, people knowing about something does not always translate into them actually doing it. This resonated with one of the key findings made by Wilson and Rezgui (2013:294) as well as with Aigbavboa et al. (2017) where poor understanding of benefits was found to be the 2nd most significant challenge highlighted in their studies.

b) Implementors not feeling environmentally competent

The role of knowledge and awareness continued to be a golden thread throughout this theme, as it also featured in the second prevalent category related to competency of implementors. 46% of the participants highlighted that they felt they lacked the professional competency to interpret and apply environmental requirements pertaining to their roles. This was implied in various expressions such as participant 21's response that "I didn't go to school for it, but you may have gone to school for it and have a better understanding" and participant 6 stating that "For a person versed in those topics, it makes complete sense. But for a person who comes from the outside and has to go through it, it takes a lot longer to work through all those, make sense of it and make sure you comply". The points raised in this category dealt with implementors feeling they do not have a good enough grasp on environmental concepts to be able to apply them effectively. The construction phase involves various activities happening all at the same time and each with a specific set of technical requirements and best practice methods. Stakeholders in this phase are therefore faced with numerous variables to

contend with. Having to adopt requirements that are outside of the implementors' field of expertise was considered a daunting task as could be interpreted by statements such as "The biggest thing is that the topic at hand is sometimes a bit challenging to understand" raised by participant 6.

This sentiment was shared by participant 8 who expressed the frustration that "Sometimes it's difficult because I'm trying to manage what's on the document, but I don't have the answers" and participant 13 who felt 'This is not my direction of work, I'm in construction. So, if you tell me don't close the channel, I need to understand the practical reasons". Implementors appear to not feel confident to address some of the application challenges or discrepancies between what is outlined on paper and what is happening on the construction sites. This can be especially prevalent in construction, where there can be unpredictability of events e.g. unforeseen weather conditions, where adjustments of actions have to be made while still aligning with environmental requirements.

This category speaks to lack of professional knowledge and expertise which, according to Marsh et al. (2020), was cited in fourteen (14) of the thirty (30) articles reviewed on challenges to sustainable construction. A similar category featured in Amatepey et al. (2015)'s study based on Ghana's construction industry where it ranked as the 4th strongest barrier where implementors were found to lack the necessary expertise to implement sustainable construction practices (Amatepey et al., 2015:1685). Similarly, Pham et al. (2020:2990) highlighted this as one of the major challenges related to incompetence of project managers, as with Opuku and Ahmed (2014:97), who referred to board members' lack of knowledge. It should not be expected of anyone to be fully conversant about everything that has to do with construction, regardless of experience. That is the reason why projects require the integration of knowledge and expertise of a variety of contributors to drive successful implementation. It is therefore pertinent that the involvement and support of the requisite environmental expertise be considered crucial for successful implementation (Amatepey et al. 2015:1685; Djokoto et al., 2014:136).

Other challenges raised that affected competency related to "requirements not being communicated clearly to the implementors" (38% of participants) and the "magnitude of the requirements" (25% of participants). With the former, participants raised concerns about relevant workers tasked with implementation who are not always included in sessions where detailed requirements are raised. This was highlighted in comments such as "At kick-off meetings they only call the CEOs, site managers, the project managers. Those are the only guys that are being told about environmental

requirements. And those are the only guys who are not on site most of the time" from participant 23. This motion is also substantiated by participant 8 who mentioned that "It seems like the guys on top i.e., directors, are the ones briefed on what is required, but when it comes to the guys on the ground who (are) doing the actual work it comes as if it's something new to them." Participants 17 and 18 also raised the concern that clients who appoint contractors sometimes do not share all relevant information. This speaks to possible gaps in training plans which involve identifying relevant stakeholders for training on requirements and poor filtering of information throughout the project team. This ties in with the training challenge category. Marsh et al. (2020) had also referred to a similar challenge related to lack of communication amongst all stakeholders that came through in eight (8) of the thirty (30) articles referenced, placing it as the least mentioned challenge in the reviewed literature.

The issue of poor communication of requirements can also be influenced by the manner in which the requirements are presented or packaged. 25% of participants raised concerns about the large volume of environmental requirements that discouraged implementors. Participant 7 candidly described it as being "bombarded with information", referring to the magnitude of information to consider. The issues around this were mostly centred around the lack of guidance in knowing which information is relevant for them. The participants who raised this concern felt that they are simply given various reports and they are expected to decipher what to focus on within each one. Participant 6 indicated this through his comment "…but we are left to look at that entire thing...if you open a pdf and see it's 1000 pages, then you hit ctrl f and then start looking for lines…". The plea in such cases was for a more succinct and basic presentation of the requirements in a manner that can be easily interpreted by the relevant recipient. Wilson and Rezgui (2013:296) referred to this challenge as a "Lack of actionable knowledge" related to "ill-structured knowledge". This speaks to instances where there is knowledge available, but it is challenging to implement as recipients are uncertain which part of that knowledge relates to their role or even how to practically implement it. Participant 7 and 14 raised this concern as they described how they were often given multiple specialist reports to work through, but with no guidance on what they should focus on as engineers. If information is shared, they need to understand why it was shared with them specifically and how should they implement it.

The rest of the five (5) challenge categories in this theme were mentioned by one (1) or two (2) participants and were therefore considered outliers. Those where two (2) people who raised a challenge that included lack of guidance for emergency situations and lack of experience by contractors or workers in implementing environmental

requirements. Where individuals raised a challenge and it was not repeated, it included lack of access to information, project managers being inundated with other responsibilities as well as smaller projects lacking detailed environmental information. When comparing these to literature, lack of access to information relates to lack of knowledge, which was one of the more prevalent challenges in literature (Marsh et al., 2020:31-32). Similar to the high prevalence in the literature findings, 79% of participants agreed that lack of knowledge was a challenge as presented in the responses to the section B questions in table 6. The other concern raised by one (1) participant about project managers having too much work also featured in Wilson and Rezgui (2013), and was referred to as *"*work overload", though the prevalence of this challenge was not indicated in the literature.

4.4.2 Environmental site support challenges

One of the ways that competency and capacity challenges can be addressed in the construction phase is through the effective involvement of environmental experts or professionals to offer much needed direction (Amatepey et al., 2015:1685; Djokoto et al., 2014:136). As was referred to in the previous theme, 46% of the participants felt they were not competent to manage and effectively apply requirements. It was therefore not surprising that one of the prominent concerns raised to address competency deficiencies had to with the involvement and support of environmental expertise. The requirements are often drafted by and received from professionals who are often educated and experienced in environmental management. It would therefore be expected that these stakeholders would play an active role in providing guidance on how these requirements are implemented. This, however, did not seem to be the experience of participants as was found from the interviews.

The categories within this theme centre around the perspectives raised about challenges associated with environmental personnel's support and are highlighted in Figure 15.

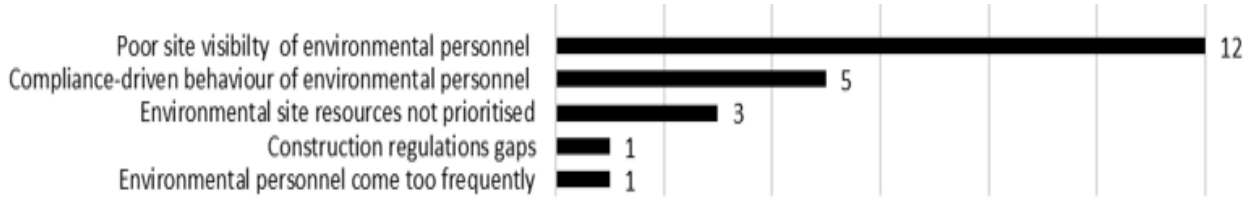

Figure 15: Challenges in Environmental Support theme

a) Poor site visibility of environmental personnel

Construction teams are often made up of professionals with varying expertise and from different knowledge arenas. With the vast range of environmental requirements often associated with infrastructures projects, oversight from environmental professionals is common practice. These environmental resources can include environmental officers, managers and various regulatory representatives. The roles of these personnel can involve monitoring compliance to environmental requirements, providing guidance on environmental best practices and driving environmental performance of projects amongst other things (Wessels et al., 2015:182).

50% of participants interviewed raised concerns pertaining to the infrequent site presence of environmental personnel. This was highlighted in various ways, where implementors generally felt that they are often left to interpret and apply requirements on site while the environmental personnel are hardly present to give guidance. Participant 17 referred to the site support from environmental professionals as being *"*non-existent". This sentiment was shared by other participants such as participants 21 and 24 who felt that environmental personnel were more at the office than on site, which is where they are needed the most.

This perceived abdication of site responsibility by environmental personnel was considered a drawback to successful implementation, as the implementors felt they needed the assurance and monitoring to ensure they are doing the right things. Participant 8 alluded to this in his remark that "we are also not comfortable; we want the environmental officers more often on site to ensure we are doing the right thing". This was substantiated by the response from participant 1 that "We are not expecting policing but we need direction of the correct way to do things." The infrequent presence of environmental personnel on site was also considered to encourage practices of non-conformance to requirements, as people tend to disregard requirements when no-one is monitoring their actions. This was admitted by participant 21 that "we sometimes dismiss it because we think no one will see that it's me who did such a thing". Environmental professionals are considered as the experts in the field and their involvement on site was considered integral for implementation success. As participant 24 aptly put it *"*It's not going to help the environment if the people monitoring the environment are not being present*"*.

The need for better site support did not feature quite as explicitly in the literature reviewed where similar research was conducted, with the exception of lack of enforcement and monitoring being cited as one of the barriers to low implementation by Abidin (2010:425). The desire for improved environmental site support can be linked to the lack of professional knowledge which Marsh et al. (2020:31) highlighted as being featured in fourteen (14) of the thirty (30) articles reviewed, including the work of Wilson and Rezgui (2013:294), Serpell et al. (2013:278) and Amatepey et al. (2015:1685). The success of implementation is dependent on having access to the relevant knowledge. Members of non-environmental project teams are generally educated and experienced in their specific fields of expertise.

The knowledge gap they may have on environmental matters can therefore not be effectively closed only through training and learning. Rather, being able to readily access knowledge and guidance from environmental personnel on site as work progresses, was seen as key to drive successful implementation of requirements.

Despite the higher percentage being concerned with poor visibility of environmental representatives, there was one participant who held a contrary view, as he felt that environmental personnel came too frequently to site. He expressed his discontent by saying “Basically, I would say that environmental should back-off a little bit then when the project is about to end come up with all the issues so it can be rectified".

b) Compliance-driven behaviour of environmental personnel

The participants, though yearning for better site visibility and support from environmental professionals expressed in the previous category, also complained about the unsavoury behaviour some environmental professionals exhibited on site. 21% of the participants lamented how environmental personnel seemed more focussed on checking compliance and raising non-conformances instead of providing guidance and support on sites. Participant 15 likened them to “speed cops” who are perceived to be more interested in fault-finding and issuing fines. A similar concern was raised by participant 8 who referred to environmental officers who “..tend to just come and write reports and findings and copy our bosses but at the end of the day the message didn’t come across”. The implementors who raised this matter felt that they were not often engaged by the environmental representatives who come to site, as there seemed to be more focus on checking how compliant they were. Instead of raising concerns with

site personnel towards resolution of issues, their attention was perceived as being on reporting. As a result, some participants developed a negative perception towards environmental personnel, which could influence how receptive they are of the requirements. This is substantiated by Blake (2001) and Kollmus and Agyeman (2002) cited by Wilson and Rezgui (2013:291), who attribute attitudes towards environmental issues as being influenced by previous experiences and feelings amongst other things. If environmental requirements are therefore associated with getting people into trouble, because of how their custodians portray themselves, then implementors may develop resistance against implementing them.

c) Environmental site resources not prioritised

In light of the importance and the perceived value of environmental personnel support on site, 13% of the participants felt that environmental resources were not prioritised for recruitments in construction. Participant 24 raised the concern that "There is no one appointed to look at environment **only** (stressed this word) but there is someone appointed to look at safety". This was echoed by others, who were of the opinion that implementation could be better if there were people appointed in the construction team to focus purely on being the custodian of implementation of environmental requirements. One of the participants attributed this deficiency to the shortcoming of the construction regulations, which do not make it mandatory for sites to have environmental representatives appointed, and so managers also disregard assigning environmental roles. There is also a connection with lack of leadership commitment, which was raised by 25% of participants from the institutional support theme. If the managers or supervisors are perceived to not take environmental requirements seriously, then chances are they may not see the need to prioritise appointing resources for that role.

4.4.3 Human behaviour challenges

The successful implementation of environmental requirements is largely dependent on people who possess free will, possess varying attitudes and exhibit a range of behaviours. Behavioural challenges featured as one of the top two (2) dominant themes, where 63% of participants made reference to negative human behaviour as one of the major drawbacks to successful implementation.

Some of the expressions used to describe these attitudes related to ignorance, disregard, negligence, dismissive and negative mindset towards environmental to mention but a few. Participant 21 who was a general construction worker admitted to some of these when he said, *"*We know the requirements are there but we don't always take them into consideration...we simply ignore them*".* Participant 23 also alluded to a similar dismissive behaviour by stating "Sometimes I think it goes with people's negligence, because you give them training on waste separation but employees sometimes they have this thing that 'me I don't care, it's not my job' ". It seemed that, regardless of how much information some implementors were provided with on environmental requirements, it was considered as something that can be ignored. Participant 7 felt that a possible lack of tangible consequence could be the reason why dismissive attitudes and resultant actions ensued. Participant 24 on the other hand attributed attitudes to "…just laziness and people just being ignorant". It appeared that attitudes displayed were a result of choosing to simply disregard requirements.

Another interesting perspective on human behaviour raised by participants 7, 11, 13 and 14 referred to how the older generation appeared to exhibit more resistant behaviours towards environmental requirements. Participant 7 made reference to his older mentor who "…used to joke that our documentation these days are 100+ pages and their documents were normally 1 or 2 pages and still the stuff got constructed*"*. This statement implied that possibly the older generation may not see the value of additional requirements if the output in the form of a product on the ground was still there. This behaviour was exhibited by participant 13 who had been in the electricity infrastructure construction industry for 50 years. His biggest frustration related to the influx of requirements over the years, which in his opinion, did not make sense. He made reference to protection of species and questioned the reasoning to a protection status being assigned to a tree that was previously not protected. He recalled another project where a line had to be deviated to protect a frog which was reportedly endangered, and expressed how he felt they were being sold lies. It was therefore challenging for a participant such as this one to be accommodative of environmental requirements if he could not make sense of it.

All these negative attitudes and behaviours can be considered as "resistance behaviours", as termed by Okoye et al. (2021). The reluctance or aversion to requirements in the reviewed literature was associated with "resistance to changing traditional processes" which featured in 57% of the articles reviewed in Marsh et al. (2020:31). This would be an attitude typically held by some of the more experienced stakeholders who have had to contend with a rapidly evolving regulatory environment to which they did not have to conform before. It is therefore not surprising that it may seem challenging to easily

assimilate those changes into practice. This resistance to change featured as a key barrier in Amatepey et al. (2015:1685) where 84% of the participants referred to it. Khalfhan et al. (2015:943) also alluded to behaviour challenges where dismissive attitudes were identified, especially amongst contractors who had more experience in construction.

Behaviours and attitudes are often the fruit of other influences, and their root causes could emanate from other challenges. One of these was the influence of treatment by leadership. Participants 16, 21,23 and 24, in sharing possible triggers to negative attitudes, touched on how managers and supervisors sometimes addressed workers in a harsh manner. This was considered to breed a spiteful and resentful attitude amongst the workers where they are perceived to intentionally disregard requirements as a way of retaliating against ill-treatment. This phenomenon is substantiated within environmental psychology, where past experiences, habits and past feelings, amongst other things can influence how people formulate attitudes towards environmental matters (Blake, 2001; Kollmuss & Agyeman, 2002 cited by Wilson & Rezgui, 2013:291). As was also highlighted earlier, the lack of a positive environmental culture within an organisation or exemplified by leadership can be another external factor that could contribute to behaviours of disregard amongst implementors. Negative human behaviour and attitudes are therefore not isolated challenges but rather could have multiple sources feeding them which would need to addressed first in order to deal with the root-cause.

4.4.4 Weak project integration

Integrated environmental management (IEM) as it applies to projects broadly refers to taking environmental management considerations into account across every stage of the project life-cycle (DEA, 2004:8). The rationale behind this is to ensure that requirements or practices that are meant to promote sustainable project delivery are not detached from the broader project but are integrated into every phase of the project. The success of IEM is influenced by how well the processes in the different project phases or stages of a project are connected or linked together, as that will facilitate better flow of information from one phase to another (Arts & Faith-Ell, 2012:3241). Project activities cannot be undertaken in isolation or exist in silos, hence the analogy of a cycle where the process flows are connected with each other. This is what is referred to as project integration in project management (Demirksen & Ozorhon, 2017:1639)

This theme was formulated on the basis of challenges that emerged from the participants' responses that were considered signs of weak integration of project processes. The challenge categories that were related to this theme are depicted in Figure 16.

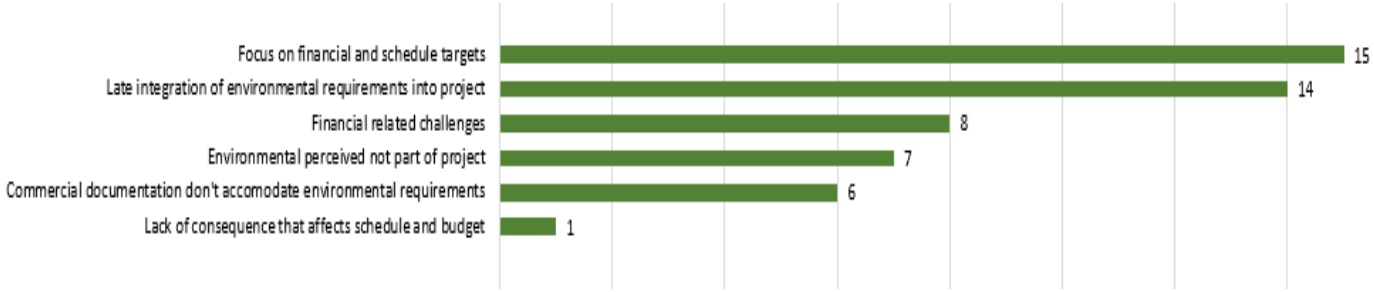

Figure 16: Challenges in weak project integration theme

a) Focus on financial and schedule targets

The most prevalent category in this theme related to environmental requirements not being adequately implemented due to a strong focus on financial and schedule targets. This was one of the top categories that emerged throughout the study. 63% of participants were of the opinion that what is pursued in construction is production. Participant 24 cleverly referred to production as *"*something that's going to be invoiced and paid for*"*. In the construction industry generally, teams are paid for activities they complete. This was also highlighted in participant 17's statement that "If I don't plant 5 poles today, then none of us is getting a salary*".* Teams are given production targets which are time bound and they are measured primarily on those. To be able to prove that work was completed they have to refer to targets met and, as with the example from participant 17's comment, how many poles were planted. Any other task that does not yield monetary value may therefore simply fall by the wayside. This unfortunately seemed to be the case when implementing environmental requirements, which in practices, was perceived to take least priority. Participant 7 substantiated this when he said "Schedule and budget take priority over everything even quality. And that gets chased harder, especially in construction, and other things are pushed aside and then try to solve them afterwards*"*. This implied that environmental requirements may be considered an afterthought and not something to be concerned about, as it may not be seen as production.

A few participants pointed to possible reasons behind this "narrow" focus on production targets. Participants 21, 23 and 24 referred to this being possibly related to

impractical production targets that teams are expected to meet. “Guys are always told that they are behind, especially in construction projects. So, their focus now is meeting the target so they don't care about other things″ was expressed by participant 23. If teams are expected to deliver work within unreasonable timeframes, then they would be under pressure to execute those instructions. In the process, other activities that need to be executed in tandem may simply be disregarded, as they would be considered as taking time away from meeting the primary targets. Another reason was associated with the idea that workers tend to focus on where they see a benefit to them based on the comment "If I'm only going to be rewarded for production then my main priority becomes production" said participant 24. It could be that implementors in the construction space may not see the benefit, in this case financial, of having to implement environmental requirements. Thus, these requirements may possibly not be considered to yield tangible, economic value for them as construction stakeholders.

The focus on economic gains overshadowing sustainability-based requirements is not an unusual phenomenon for the construction industry (Serpell et al., 2013:276; Wilson & Rezgui, 2013:300). The pursuit of financial gain also surfaced in literature, where Serpell et al. (2013:283) indicated that close to 70% of participants considered economic needs as taking higher priority in construction. These results are synonymous with those of this research study, where 63% of participants admitted to focussing more on financial and schedule targets. A similar trend was seen in the Likert scale-based questions, where 79% of participants agreed that there are other priorities in construction, and these also centred around meeting budget and schedule targets. This trend can possibly be attributed to the “profit-driven” nature of the industry, where sustainability related objectives are often considered as luxuries that can be done away with (Abidin, 2010:425; Opuku & Ahmed, 2014:97). A change of culture may be required where environmental requirements are integrated into project targets against which project performance can also be measured.

b) Late integration of environmental requirements into project

According to Abidin (2010:425), for environmental requirements to be taken into consideration in the project processes, they need to be communicated and integrated from the early stages of the project. This principle did not appear to be well applied, as interpreted from the experiences of the participants. 58% of them relayed concerns pertaining to late integration of environmental requirements into the project. Participants 1 and 2 referred to instances where construction progress was delayed because environmental stakeholders were only called in when there was a situation

found on site. Upon investigation, it was realised that environmental experts were not consulted to assess the project area prior to commencement of construction. This was highlighted in the comment “When the line fell, they saw there was corrosion on the stays. By then they could have called you in before we constructed”. These situations could possibly have been avoided if environmental teams were involved earlier and their inputs obtained for detailed planning purposes.

Requirements that emerge during the course of construction was another example that was a source of irritation for participant 17 who complained that “We were busy with the line and we were planting the poles then they decide whoa there's now wetlands. Where's the information from the beginning". Upon further elaboration, this participant associated this incident with poor EIAs, as specialists possibly missed certain features in their assessment and their oversight impacted construction work.
A similar challenge was shared by participant 18 who commented “No one knew and we almost dug there… No one picked that up and just imagine if that person didn’t come, we were just going to dig". The latter comment referred to a situation where graves were discovered along the line route only because a community member “rang the alarm” when the construction was already underway. The impacts of such situations would be delays to construction work, as time would typically have to be set aside to apply for relevant permits, failing which, planned routes or site locations would have had to be changed. The frustrations caused by these inefficiencies were expressed by participant 6 that “It also becomes challenging and frustrating that after you had done everything then you are told you have to change it, that is frustrating for a lot of people".

The impacts of the above incidents on projects often are delays and unforeseen additional costs that need to be taken into account. These could have been avoided if the requirements and associated costs were known earlier. This was emphasised by participant 7 in response to whether environmental requirements caused delays and he responded “It only causes delays if there wasn't sufficient knowledge of the requirement upfront”. On a similar question about environmental requirements increasing costs, participant 12 held a similar view that “They are not expensive, as long as we know from the start of the project that this is going to cost this much”. Thoroughly informed planning plays a crucial role to ensure successful implementation during construction. If planning is rushed, or all relevant stakeholders are not engaged and involved in the earlier phases, the subsequent phases will unfortunately bear the consequences. The examples related to oversight from the EIA phase justifies the

need for more EIA follow-up where findings of the assessment phase require verification during the implementation phases (Morrison-Saunders et al., 2021:3). In cases where the relevant specialists who did the EIA are no longer part of the project, the opportunity for learning and improvement of assessment methods would therefore be missed.

Challenges related to delayed integration of environmental requirements were highlighted in literature by Marsh et al. (2020:31), where 33% of the reviewed articles cited a barrier of "lack of integrated work environment and communication among all stakeholders". Serpell et al. (2013:283) also alluded to a challenge of construction projects being planned without effectively integrating stakeholders. The latter author made specific reference to designers who performed their work in isolation from other stakeholder inputs, which is relevant to this research as well.

Similarly, Pham et al. (2020:2990) pointed to the challenge of lack of an integrated work environment as a barrier that ranked 9th compared to the others in their study.

As could be seen in the earlier examples of late involvement of environmental teams, working in silos causes avoidable negative impacts to construction progress. Aigbavboa et al. (2017:3009) also made reference to "lack of co-ordination of resources" as one of the challenges that emerged from their study, though it was not clear in these articles as to what this barrier entails. The prevalence or prominence of this challenge category in this research study was higher (58%) compared to the reviewed literature, where it was not found to feature as distinctly.

Arts and Faith-Ell (2012:3242) advocates for earlier engagement in the planning phases with stakeholders who would typically only be involved during the implementation phases. In this way, it is believed that insights gained from these engagements would benefit better detailed planning that would improve more effective implementation. This perspective corroborates the results from the Likert scale-based questions, where 67% of participants agreed that they were not engaged in the planning phases. The earlier point made by Arts and Faith-Ell (2012:3242) definitely does have merit as, the people involved primarily in the planning phases often do not have the implementation insights that could aid in better planning methods. This relates once again to one of the strengths of follow-up, which includes enabling a "feedback loop" of information gained from the implementation phase back to the planning phases towards learning and improvement of processes (Morrison-Saunders & Arts, 2004:6; Marshall et al., 2005:177; Morrison-Saunders et al., 2007:3; Arts & Faith-Ell, 2012:3250; Morrison-Saunders et al., 2021:7).

c) Financial related challenges

According to Wilson and Rezgui (2013:300), the construction industry often operates within restrictive budgets and various trade-offs often need to be made, resulting in sustainability being compromised. One of the challenge categories raised by participants related to this was financial challenges associated with environmental requirements. 33% of participants raised concerns around the financial implications that deter successful implementation. One of these concerns had to do with implementation not yielding any financial returns and making money was considered one of the main goals of any contractor. As stated by participant 7 “If they (contractors) know they would get paid for something, they would do it. vs something, they were supposed to cater for and there was no benefit to them”. The rationale behind this thinking is that implementing environmental requirements was not considered to contribute any return on investment as plainly stated by a contractor “... it's a business at the end of the day; a business is there to make money”. Focus during construction would therefore be geared towards activities that bring in revenue.

Along a similar line of thought was the perception that implementation of environmental requirements increases project costs. The responses from the Likert scale questions indicated that 54% of participants agreed with this. However, further elaboration during the interview revealed that the increase of cost was as a result of other factors. These included inaccurate estimations for environmental items being provided, unforeseen environmental events or requirements that introduced new costs, late integration of environmental requirements, having to address incidents caused by human error and requirements not incorporated into contracting documents, to mention but a few. There were, however, isolated statements where participants did feel that some conditions on permits can be relooked at to consider alternatives that are economically viable. An example of this was presented by participant 9 who referred to instances where dust suppression using water is required in the EMP. Such conditions were considered to add unnecessary expense, due to water scarcity issues experienced in most parts of the country.

The perception of the increase in financial burden introduced by environmental requirements was also a common trend in reviewed literature.

Marsh et al. (2020:31-33) noted that 43% of the articles highlighted this challenge. This was also highlighted as the main barrier in Khalfhan et al. (2015:943) and as the 3rd ranking challenge presented in the study by Djokoto et al. (2014:138). Abidin and Powmya (2014: 38) highlighted that there was a prevailing mindset that sustainable construction was not deemed by contractors as economically viable, as it increases project costs. Similarly, the fear of higher costs ranked highly as one of the top five (5) barriers amongst other studies (Okoye et al., 2021:6; Amatepey et al., 2015:1684). The prevalence of this challenge in literature is contrary to those in this study, as financial challenges was not ranked as highly, with only a small percentage i.e. 33%.

Though not as prevalent amongst the group of participants in this study, economic concerns need to be addressed as a reality. One of the ways that could be explored is the weak integration factors that contribute to increased costs. Serpell et al. (2013:285) is also of the opinion that ways need to be found for companies to realise the value or benefit of following environmental requirements.

If companies can understand what benefit sustainable practices bring to their operations, then hopefully their perspective on its importance will filter into their economic decisions.

d) Environmental not perceived part of the project

One of the patterns interpreted through the participants' responses was that environmental requirements seemed detached from the rest of the construction work. This was not so much from statements explicitly indicating that, but rather how reference was made of focus being on the project and not on other things. This came across amongst 29% of the participants, where having to consider environmental matters was seen as extra work that distracted them from production activities.

Participant 16 was quoted as saying "Remember the project, it's a business, so they need money so they will always focus on the project more than anything". This statement implied that any other activity that is not considered to generate revenue would not be considered part of the project One of the general construction workers, participant 21, also alluded to implementing environmental requirements as not being part of his responsibilities. This was interpreted from the response: "I sometimes see that I have my own specific task to complete and I leave the mess there after I completed my work". This showed that there was a perception that environmental concerns were not part of their responsibility.

The perspectives upon which this challenge is based are closely related to those in the category of “focus on schedule and financial targets” discussed earlier, as well as that of a lack of an integrated work environment, highlighted by Marsh et al. (2020:31). This challenge also refers back to Pham et al. (2020:2990), who referred to the “lack of an integrated work environment among stakeholders” as an identified challenge. If implementors consider implementation as an extra job, that could contribute to their reluctance to carry out what is required. This may especially be the case if the targets that they are given by their superiors do not emphasise or incorporate fulfilling environmental requirements as part of the work they are measured against.

e) Commercial documents do not accommodate environmental requirements

Prior to the construction phase commencing, construction teams or companies are often provided with the details about the project, including scope, technical, environmental and other requirements they need to plan for towards the construction work. However, 25% of the participants indicated that environmental requirements were not well incorporated in the contract documentation. This gap made it difficult for planning and budgeting purposes, which then culminates in requirements not being implemented during construction.

Participants 2 and 3 made reference to cases where established contracts did not include sections where contractors could include costs to cater for environmental requirements. As stated by participant 2: “Anything that is not on the outline agreement cannot be paid for because those activities are already on the system so if there are additional things you need to cover yourselves”. Such a situation places a burden on contractors to address issues that may have financial implications on site, as they will not be able to invoice for it against a fixed-items contract. A related concern was raised by participant 5: “If I'm not sure of cost implication or it's not in the BOQ (Bill of quantities) then my focus is on the technical scope”. In the case of the latter comment, contracts that are not “fixed” would still require that environmental activities that may have a cost implication be outlined clearly for the contractor to price against. In the absence of this integration, project budgets may not be reflective of environmental requirements. This concern was indicated by participant 12 who, being a project manager, relied on communication from the environmental teams to indicate what

needs to be incorporated. What was interesting to note was that sometimes contractors were willing to omit environmental costs to try to align with preferred tender cost margins or projections communicated by potential clients.

The challenge of contractors trying to manipulate their project budgets to fit a pre-determined cost is also counter-productive if those estimations do not cater for site specific requirements. This is emphasised by Opoku and Ahmed (2014:98), who are of the opinion that most construction contracts do not cater for sustainability considerations, neither does awarding contracts to the least priced bid. In proposing some solutions, Arts and Faith-Ell (2012:3241) advocate for contracts to be more project- and scope specific instead of being designed around generic scopes.

This is especially important as projects sites and receiving environments are rarely 100% the same. Communication and integration amongst multi-expertise stakeholders should also be promoted to inform the commercial processes (Wilson & Rezgui, 2013:303).

This particular challenge could not be found as clearly in the literature where similar studies were undertaken. This is with the exception of Serpell et al. (2013:283) where it appeared as the 4th ranked barrier where environmental costs were being omitted from overall cost structure.

f) Lack of consequence that affects schedule and budget

There was one outlier challenge raised in this theme. One (1) participant indicated that one of the gaps that encouraged contractors to avoid integration of environmental requirements within their activities was related to lack of consequence. As stated in his own words:

"If you want to influence that, you must influence what touches them, which is schedule and budget. But if you keep it as a soft target just on the basis that it's important and they need to comply without touching their schedule and budget, then you are not going to get them to move" *(Participant 7)*

4.4.5 Delays to construction

Accommodating environmental requirements has been commonly associated with causing delays and bottlenecks along the process and believed to hamper development progress (Bond et al., 2014:46; Roos et al., 2020:1; Morrison-Saunders et al., 2014:2; Kidd et al., 2018:1266; Oosthuizen et al., 2018:159; Nel & Alberts, 2018:18). This perception also emerged from the participants' responses where 42% of them expressed a similar concern.

The construction phase is very production driven where teams are given daily output targets which are linked to financial targets. In other words, income is dependent on the portion of work completed. Teams will therefore tend to set their sights on completing their work tasks and would not look favourably on anything that is perceived to cause delays. This could be interpreted from statements such as "The time I'm taking handling the spill, the machine is waiting for me to operate it to continue working" made by participant 21. Attending to a spill in this case was seen as taking time away from focusing on work.

The root cause of the delays was associated as emanating from processes external to the immediate construction activities. Participants 13, 14, 19 and 20 highlighted the issue of slow turn-around timeframes of government departments who are relied upon to issue environmental permits. "The government departments hardly keep to their timeframes" was expressed by participant 13 and was echoed by a frustrated participant 20 who complained that "we have been stopped for 3 months waiting to be given a go ahead…3 months now. 80% of the work is done now on the project, so for how long do we still have to wait?". Sluggish processes were not the only root of delays, but the problem appeared to infiltrate internal business processes. Participant 3 raised a concern over procurement and supply chain processes that did not cater for dealing with environmental emergency incidents that arise. Instead of having systems that promote effectiveness, there seemed to be more red tape to cross, which hampered progress. Participant 13 further emphasised the slow commercial processes and placed them at the centre of most delays by stating "If our procurement was able to deliver quicker then it wouldn't even be a topic". A crucial point that came forth, as presented by the latter participant, was that it is not so much that the requirements themselves cause delays, but rather the processes associated with fulfilling the requirements. Participant 22 provided insight on what she picked from fellow project managers that "…they just don't want it to be part of the project, they feel it causes a delay". In such cases requirements may become tainted as a hindrance due to the drawn-out administrative processes, which can fuel reluctance to successful implementation.

Occurrences of poor planning also came to the fore as a source of delays. Participants 17 and 18 both worked as construction managers for different companies and gave accounts where they had to pause construction due to requirements that were missed by their clients. These related to gaps in environmental impact studies where graves and wetlands were missed during the EIA phase. These features were only identified during construction, and work had to be paused, while in other cases the powerline route had to be changed to accommodate the findings.

Such cases cause the validity of environmental impact studies and the process thereof to be questioned. This could be seen from participant 17 who commented:

“That's the small environmental issues we sometimes face with environmental impact studies that's been done 5 years ago and left and now we start building and new things pop up.”

It is therefore important that the findings of EIAs from the planning phase are reviewed against construction phase outcomes as part of EIA follow-up. Fraser and Russel (2016), cited by Morrison Saunders et al. (2021:3) highlighted this as being one of the key roles of EIA follow-up which is to attend to any gaps or vague areas from the planning phases that can be better clarified in the implementation phases of projects.

The perspectives on environmental requirements being associated with delays also came across in the literature reviewed. Marsh et al. (2020:31) indicated that 33% of articles reviewed on barriers made reference to implementation being considered a *“time consuming*” exercise. The prevalence of this challenge amongst the literature was low overall, as was the case in this study where 42% of the participants highlighted it. This was also the case in the work of Amatepey et al. (2015:1684) where “delays in decision making” ranked as the lowest cited barrier amongst the interviewed sample of thirty-four (34) participants. Regardless of this apparently low prevalence, any factor that threatens successful implementation of environmental requirements does merit attention if improvements for the construction industry are to be attained.

4.4.6 Validity and clarity of requirements

This theme incorporated challenges that related to areas where participants questioned or had concerns with the environmental requirements specifically. The categories to be discussed can be referred in Figure 17 below:

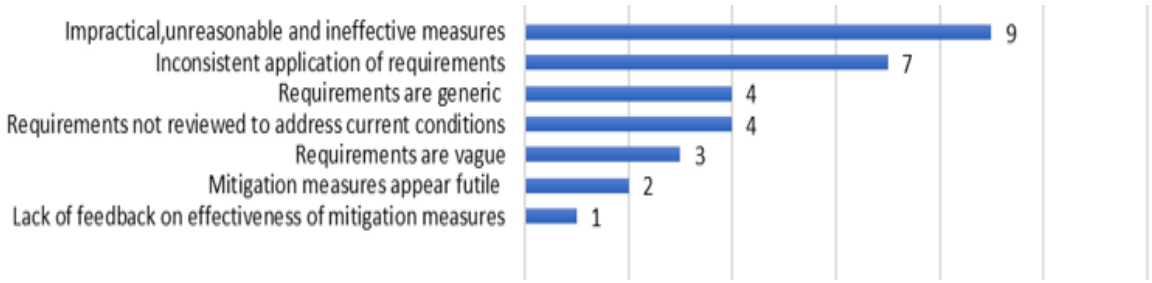

Figure 17: Challenges in validity and clarity of requirements theme

a) Impractical, unreasonable and ineffective measures

37% of participants expressed that the environmental requirements were not easily implementable due to their impracticality. Some were considered to be unreasonable and ineffective. Examples of comments that were evidence of this were raised by participant 4, who addressed instances where there is a condition that a contractor needs to take pictures of the project area before work commenced and afterwards. The reason behind this requirement would typically be to obtain evidence of the condition of the site, in order to track the project impacts. For substation projects it may be easier, as the site would be in one fixed area. For powerline projects the dynamics change dramatically, especially for longer lines. Such a condition was considered onerous as lamented by participant 4: "It's so impractical to drive a line and climb out every 50m to take a photo, it doesn't make sense". A similar comment was highlighted by participant 18 in recalling a common condition of being prohibited to refuel on site and he questioned the logic behind it when he complained that “You have an excavator on site and it's 50km within the site [away from site camp]. There is a condition that there is no filling [of fuel] on site, now how are you going to fill that

excavator?" Contractors especially felt that requirements appeared to be taking into consideration theory but do not consider the complexities on site.

As a result, participant 8 emphasised the need for the writers of requirements to get a practical experience of construction sites in order to understand the complexities of their work. Some of the requirements were perceived as unreasonable. An example of this was expressed by participant 9 referring to an incident where he was given instruction to carry oil-spill kits that could accommodate the full capacity of a diesel container that he was transporting. The irrationality of this requirements was that the container only contained 30% of its capacity at the time but he was expected to drive around with a vehicle full of spill kits accommodating a 100% capacity spill. This participant described the incident as being “a little bit ridiculous” and “just taking it too far”. Implementors seemed frustrated that some requirements did not fully consider effectiveness. Participant 9 also expressed his discontent that:

“What frustrates me on construction is having drip trays for vehicles that are stationary but when it's driving around there is no drip tray following it so then it messes everywhere. So, you put costs to get drip trays that may not solve the problem”.

From discussions with the participants, they did not seem to be against the measures proposed, rather their concerns were predominantly rooted on site practicality and whether effectiveness was tested. It is suspected that some of the requirements may be drafted by personnel who may not have the construction experience or exposure required to draft informed guidelines. This was highlighted by Arts and Faith-Ell (2012:3241), that impractical requirements may be a result of planning stakeholders that may not have the implementation insights. Participant 8 raised this point, specifically highlighting the role of environmental personnel in reviewing impractical mitigation measures.

He stated the following:

“If it was possible to have the environmental officer on site more often then they will see some of the activities and see that when I draft this document in future maybe I should change a bit.”

This challenge may unfortunately recur if there is no feedback provided to the drafters of requirements to be able to re-assess their approach. That is a gap that the follow-up process is meant to close. In the case of projects for which an EIA was undertaken,

involvement of the assessment practitioners and specialists in construction could afford the opportunity for improvement of impact management measures (Marshall, 2004:118; Morrison-Saunders et al.,2021:7). Unfortunately, in most projects, the people who were responsible for the EIA phase are no longer contracted for the construction phase. Implementors are therefore left to navigate the challenges bred in the planning phases largely on their own.

In an effort to address the concern of impractical requirements, participant 4 suggested the frequent engagement of non-implementors, specifically those experienced in construction, where they can give inputs on proposed measures in the earlier planning phases. This can be in the form of frequent contractor forums where they can be involved in providing their insight and collaboratively proposing solutions and more practical measures that can be considered. For projects where a regulated EIA is undertaken, such an initiative can be integrated as part of the public participation. During these processes, stakeholder forums can be held which specifically target construction companies or relevant stakeholders in that industry. Similar processes can be followed for projects that did not require a regulated EIA. Durning (2012:8) also indicated that successful EMP implementation relies on the involvement of construction stakeholders in influencing and drawing up mitigation measures. In this way, areas of impracticality could be minimised during the construction phase. Similarly, Broderick and Durning (2006:23) are of the opinion that the contents of an EMP need to be accepted by all stakeholders. It would therefore contribute to better implementation if construction stakeholders were engaged intently during the formulation of such documents that will need to be implemented. This could possibly contribute to addressing the challenge of “lack of earlier engagement” where 67% of the participants agreed that they are not engaged when requirements are planned as interpreted from the Likert scale-based questions.

Reference to impracticality of requirements cited as a challenge was not evident from the literature reviewed.

b) Inconsistent application of requirements

Most of the stakeholders interviewed have experience in multiple projects and therefore have broader insight of challenges from different sites. Against the context of this experience, 29% of participants raised concerns that requirements were not applied in the same way for all sites.

Participants 8 and 15 referred to the inconsistent application of requirements between the construction teams and other members of the public. They highlighted that there was an expectation for the teams on site to follow measures that others were not expected to. The examples provided included landowners being seemingly allowed to undertake activities that went against legislative provisions and best practice measures outlined. As participant 8 state that “it doesn’t make sense that we would not be allowed to drive through wetland, and it needs to get demarcated, but the landowner is seen driving through it every day because ‘it's his land’ ". Another similar example was referred to by participant 15 who complained that landowners seemed to be exempt from cutting species listed as protected, whereas on the same property construction teams were prohibited. This supposed “double-standard” was deemed as discouraging implementation and undermined the validity and benefit of following what was required. Another matter that was highlighted was the perception that environmental professionals emphasised requirements that were suited to their individual fields of interest or expertise. As communicated by participant 15: ″In my opinion with environmental, it depends who is in charge and who wants it". It seemed therefore that the importance or focus on specific requirements depends on the subjective preferences of the environmental personnel tasked with monitoring compliance or conformance.

A concern that was not directly related to inconsistencies with application of requirements was raised by participant 4. This challenge related to contradictions that existed between technical engineering standards and environmental requirements. In the case provided, the technical standard outlined that excavated soil can be spread around the base of the erected pylon. However according to the participant, the EMP contradicted that and prohibited such an action.

These inconsistencies placed implementors in a dilemma as there was no clear direction as to which requirement in this case supersedes the other. This could possibly be resolved through further engagement between the technical and environmental experts in efforts to clear any uncertainties for implementors.

These are only but a few examples where inconsistencies create a barrier to effective implementation of requirements. In the literature reviewed there did not appear to be much evidence that directly spoke to inconsistency challenges. However, Wilson and Rezgui (2013:294) did make reference to challenges related to uncertainty and

scepticism about sustainable construction on the basis of “consistency, validity and authority” of information sources.

The challenge explored here highlighted factors that could lead to implementors doubting and questioning the need to implement. This is especially the case where other stakeholders in the same environment are not held accountable to the same standards of conformance.

c) Requirements are generic

16% of participants raised doubts about the validity of the requirements on the basis that requirements did not appear to be context or project specific but were rather generic guidelines. Participants 1 and 5 expressed this concern and felt that the requirements appeared to be a *“*copy and paste” *and* “desktop” exercise. Participant 1’s response indicated that:

“Every now and then you get a document, the same things you found on a previous project you find them there as they are. So, it felt like these are just general statements for all projects but are not project specific.”

When there is a growing perception that requirements are generic, implementors indicated that they lose interest in reading them in detail, let alone applying them, as they doubt their relevance.

Participant 8 held similar views, with specific reference to conditions on water use authorisations where water quality tests and monitoring is required, but where there is no impact on the actual water during powerline stringing operations. As he emphatically stated:

“My argument is that we are not directly impacting the water. The only time we work around the river or stream is when we are stringing across the watercourses. And even during stringing, a guide wire is thrown across to the other side of the water and the conductor is taken up/strung up with the assistance of the guard wire. So, there is zero % impact on the water.”

This particular example links back to the concept that compilers of requirements often may not have the exposure or understanding of how work is conducted on site. As a result, the requirements may end up being considered “over-kill” in an attempt to prevent impacts that are not even related to the actual construction activities. The

opposite could also be true that some important impact management measures could be omitted from requirements as a result of not fully understanding the activity.

d) Requirements not reviewed to reflect current site conditions

Participants 1, 11, 17 and 20 were concerned that during construction they relied on documents that were compiled historically and did not reflect existing conditions. This was reflective of 16% of the participants interviewed.

Participant 11 put this point across plainly that:

“Whoever made those requirements must keep on reviewing them to see if they are practical. Can’t use controls established years ago and think they are relevant today”

Participant 20 was of the similar view and emphasised the role of environmental experts in addressing this matter:

“When enviro visits sites during construction they should also see what conditions may be problematic and see how the requirements can be reviewed.”

The level of certainty of impacts and measures that were predicted in the planning phases can best be verified at implementation when the actual work is done. This reiterates what Marshall et al. (2004:128) referred to about the value of planning only being seen in the execution or implementation phase. This further emphasises the need for more effective follow-up that not only focusses on evaluation and monitoring of conformance to impact management measures. The process needs to also integrate the management aspect, where decisions need to be taken to review measures towards improving their effectiveness (Pinto et al., 2019:10).

e) Requirements are vague

Similar to the previous category, 13% of participants complained about some of the requirements being unclear, leading to multiple interpretations and confusion, especially with little guidance on site.

Participant 3 highlighted an example where they were required to indicate the square metres where trees had to be cut. What made this problematic was that the trees were reportedly spread out over some distances from each other on site. This sentiment of unclear requirements was echoed by participant 1 who responded:

"There will just be a requirement that you should choose a suitable area then you look around and wonder what qualifies as suitable."

The plea in such instances was that requirements need to be written in a manner that can be easily interpreted and applied by an implementor. This is especially important when there is little site support from or ready access to environmental professionals on site.

f) Mitigation measures appear futile

Two (2) participants (8%) indicated that some of the mitigation measures proposed appear futile when compared to the broader impacts outside of the immediate project context.

Participant 5 gave an example of a common mitigation measure to cover topsoil heaps to protect them from being blown away. He was of the opinion that the protection of a few isolated heaps of topsoil would not make much of a difference compared to the high volumes that frequently get blown away by windstorms.

Participant 5 also presented the concerns that he encountered from construction workers. In this account he mentioned the following:

"They will tell you that if you are trying to solve erosion at a structure, then they will show you that the broader area is already overgrazed and already has erosion. So, you're trying to fix erosion around the structure but the area around is already highly eroded due to overgrazing by landowner."

Based on these examples, the overall effectiveness of mitigation measures seems to be doubted against the broader environment. Such sceptical perceptions can possibly affect how well requirements are implemented. If stakeholders do not see the point of doing something, chances are they may not carry it out fully.

g) Lack of feedback on effectiveness of mitigation measures

The one (1) outlier on this theme was indicated by participant 13, who in questioning the effectiveness of mitigation measured, made the statement that:

“We may not see the benefit of say installing bird flappers because we have not seen birds electrocuted, they do but it happens when we are not there and we never received that feedback"

The above statement implies that implementors may just be following requirements but without getting the insight behind those measures being deemed effective.

4.4.7 Institutional support

The theme of institutional support was one of the least dominant themes, but the views raised are still noteworthy. The implementation of environmental requirements, though reliant primarily on the efforts of individuals involved in construction, is also influenced by factors external to the implementors. In their responses, two (2) of these contributing factors were cited as challenges:

a) Lack of leadership commitment

Pham et al. (2020:2994-2995) emphasised that strong management commitment and ability to instil a positive culture of sustainable practice is crucial to drive sustainable construction. 25% expressed that this was often lacking from government, construction managers, team leaders and supervisors on projects.

Participant 24 was of the opinion that the problem emanates from higher level regulatory bodies that "If the government can also take environmental seriously and when they are giving out tenders, force contractors to comply".
This statement was in relation to the construction regulations where there is a perceived scanty reference to environmental personnel being mandatory on construction sites. Along a similar vein participant 2 considered that the country’s leadership appear to view environmental requirements as a hindrance to development. This perception was sparked by the South African president’s announcement on 25 July 2022 about the relaxing of environmental permitting requirements to address the energy crisis (South African Government, 2022).

Based on these examples, these participants felt that, if government did not seem to hold environmental requirements in high regard, then how different would the attitudes be of people who are meant to implement them. Filtering down to project sites, participant 8 indicated how they struggle to drive implementation if the leadership of the contractor team is not supportive of environmental priorities. It boils down to the

prevailing culture whether it esteems sound environmental practices as stated by participant 11: "If I'm in a company that takes those things into account, then I myself will be very cautious and know that these things must be in place". This was a perspective upheld by participant 10 who reflected on the role of management commitment in implementing management systems throughout business operations. Successful implementation will therefore be hindered where a positive environmental culture is not driven by relevant leaders who hold influence over team members' actions. Lack of leadership commitment emerged as a challenge in the reviewed literature, though the prevalence varied. Examples include Wilson and Rezgui (2013:297), where reference was made to lack of supportive organisational culture which was a high-ranking challenge under the theme of organisational barriers. Similarly, organisational culture challenges were cited by Okoye et al. (2021:7), including Amatepey et al. (2015:1689) where lack of lack of leadership was a barrier that emerged in their study.

b) External stakeholder inefficiencies

8% of the participants raised concerns about external institutions whose inefficiencies affect successful implementation. Participant 13 made reference to "government departments hardly keep to their timeframes", referring to departments who are responsible to issue approvals and permits to be implemented. Poor local government processes were also considered a stumbling block, as indicated by participant 12 who despondently stated "The contractors, when they dispose there, they must get a receipt as proof that they have disposed. But you know how our municipalities are, they are not organised". The hindrance caused by poor service delivery was also touched on, albeit by one (1) respondent in Abidin and Powmya (2014:38) but did not seem to feature as a specific challenge in the rest of the literature reviewed.

4.5 Chapter summary

In this chapter the results from the interviews were presented according to the sections of the interview guide and their relation to the research objectives. The results from section A indicated that there were thirty-one (31) individual challenge categories that were raised by participants and these were categorised into seven (7) broad themes presented in the form of graphs. Each

challenge was discussed and elaborated upon based on evidence of quotations from participants and relevance to literature. There were five (5) challenges which were highlighted by ≥50% of participants and these were: focus on financial and schedule targets, training challenges, poor visibility of site support; late integration of environmental requirements as well as negative behaviour and attitudes.

The results from the Likert scale-based questions from section B of the interview guide were also presented in graph format. The visual representation of the findings was presented in percentages of agreement and disagreement per challenges listed. Over 50% of participants agreed with seven (7) of the listed challenges in section B and there was a disagreement with two (2) challenges by over 50% of the sample. Similar to the results from section A, these results were discussed and interpreted against the findings of existing literature.

CHAPTER 5 CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

The research question which this study aimed to answer was to explore what challenges non-environmental project team members experienced in implementing environmental requirements for construction of electricity infrastructure.

In order to answer the above question, two (2) research objectives had to be addressed, which were the following:

Research objective (RO) 1: To identify common environmental requirements associated with construction of electricity infrastructure

Research objective (RO) 2: To investigate the challenges non-environmental project members experience that hinder successful implementation of environmental requirements for construction of electricity infrastructure

In addressing the research objectives, reference was made to existing literature and interviews were conducted with participants who met the relevant criteria, to provide relevant perspectives. This chapter presents the key findings and conclusions as well as recommendations.

5.2 Conclusions

The concluding remarks are separated according to the research objectives and provide a summary of the findings and conclusions per objective.

5.2.1 RO1: To identify common environmental requirements associated with construction of electricity infrastructure

The first research objective was primarily addressed through a review of the literature to identify the common requirements applicable to the construction of electricity infrastructure. The responses from the interviews were also used to solicit insights from the participants on the requirements they encountered. The types of literature sources used included promulgated legislation and regulations, academic articles, industry standards and best practice guidelines.

The findings indicated that these were the common environmental requirements applicable to construction of electricity infrastructure:

- Conditions found in Environmental Authorisations (issued by regulatory authorities upon approval of EIA documents)
- Conditions in permits issued as per various environmental legislation inclusive of
  - Water use licences
  - Biodiversity permits (Fauna and Flora related)
  - Heritage management permits
  - Waste licenses
- Environmental Management Plans or Programmes (emanating from legislation or as a self-regulatory tool)
- ISO 14001 based provisions

It is important to note that the above is not conclusive list of every possible requirement that could be applicable to electricity infrastructure construction. It is rather an indicative list of what was found to be relevant based on the context of this study.

5.2.2 RO2: To investigate the challenges non-environmental project members experience that hinder successful implementation of environmental requirements for construction of electricity infrastructure

RO2 was addressed primarily through interviews that were conducted according to the methodology described in Chapter 3. The results from the interviews revealed thirty-one (31) challenge categories analysed from the interview responses which were further categorised according to seven (7) broad themes (refer to Figure 11). The details on the theme arrangement and discussion on the details of each challenge were outlined in Chapter 4.

In this chapter, the key findings, conclusions and recommendations to be discussed will focus on the five (5) most prevalent or dominant challenge categories across the sampled data. This refers to challenges which were mentioned or referred to by ≥ 50% of the participants which were:

- Focus on financial and schedule targets (63%)
- Negative behaviour and attitudes (63%)
- Late integration of environmental requirements (58%)
- Poor visibility of environmental personnel (50%)
- Training challenges (50%)

a) Focus on financial and schedule targets

One of the challenges within the weak project integration theme was related to the focus on financial and schedule targets. 63% of participants cited that the dominant focus on these two (2) aspects of the project in construction was one of the key challenges that contributed to ineffective implementation of environmental requirements. A similar trend was picked up from the Likert scale-based questions, where 79% of participants agreed that there are other priorities in construction, and most were related to budget and schedule targets This implied that construction phase stakeholders regarded meeting financial and completion date targets as being of a higher priority than environmental requirements. In the construction industry, production is understood to be the main focus, as payments are made on the basis of key activities completed. Participant 24 described production as “something that’s going to be invoiced and paid for”. Effort and activities were therefore generally channelled towards accomplishing production targets, which seemingly were not inclusive of environmental requirements.

Participants 23 and 24 attributed this limited focus on achieving production to impractical targets given to workers, which force them to rush, in the process compromising adherence to environmental requirements. It was also highlighted that workers will focus on areas that have tangible benefits to them, and in this case the main benefit is financial gain. This perspective of economic gain often over-riding sustainability priorities in construction is evident in literature as outlined by Serpell et al. (2013:276) and Wilson and Rezgui (2013:300). Similar trends were noted by Abidin (2010:425) and Opuku and Ahmed (2014:97), who noted concern about the “profit-driven nature” of the construction industry, which contributes to environmental sustainability being considered a luxury to implement. What could also be a contributing factor is how project success has been traditionally measured according to project management principles of meeting scope, time, budget and quality (Opuku & Ahmed, 2014:97; Martens & Carvalho, 2016:30), which possibly influences what project managers put their focus on.

The existence and high prevalence of the focus on financial and schedule targets (63%) amongst the participant sample is closely aligned with similar studies. An example of this was Serpell et al. (2013:283), where 70% of the participants in that research considered economic needs as a higher priority in construction. This challenge category is closely related to that of environmental requirements being considered a source of delays to project progress, where 42% of participants indicated it as a challenge, as also highlighted by Marsh et al. (2020:31).

Similarly, it links to another challenge discussed in Chapter 4 regarding environmental requirements being perceived as detached from the bigger project. The relationship between these three (3) challenge categories alludes to a possible need to better integrate environmental management into the broader project management processes. This could contribute working towards a unified goal of sustainable construction and ensure integration of environmental requirements into the way projects are planned, designed and executed (Amatepey et al., 2015:1685; Magano et al., 2021:2).

A recommendation to better incorporate environmental requirements into the construction phase was suggested by participant 7. This involved including environmental holding points within the project's milestones that are related to payments for work done within a certain time. For instance, include verification of environmental requirements which are to be checked at certain points along the project timeline. If a certain requirement is not fulfilled at that milestone then the work cannot progress to the next stage or payments not made until the requirement is addressed. This may possibly contribute to improving the value, and influence environmental management with construction stakeholders if it affects their financial and schedule target.

b) Negative behaviour and attitudes

63% of participants made reference to negative human behaviour and attitudes as being one of the major barriers to implementing environmental requirements. This challenge category shared the top spot with "focus on financial and schedule targets" discussed above.

Some of the descriptive words used by participants to refer to these behaviours and attitudes included "disregard", "ignorance", "negligence", laziness and "stubbornness", to mention but a few. During the interviews participants who referred to this challenge were asked to provide their thoughts on what contributed to these attitudes. Some of the perspectives raised mostly related to a prevailing mindset and culture that could not be linked to a particular source. Participant 21, who was a general construction worker, explained how they are taught about environmental requirements and generally know what is expected, but they just chose to ignore or disregard them. This was echoed by a number of other participants, that people tasked with implementation sometimes simply decide to act in a manner that is contrary to what is expected of them or what they were trained on.

Okoye et al. (2021) broadly categorised such behaviours as *"*resistance behaviours"*.* In the literature where studies of a similar nature were done, categories related to this were found in Marsh et al. (2020:31), where 57% of the articles reviewed referenced a similar challenge. In individual studies it also featured as the main barrier in Amatepey et al. (2015:1685), where 84% of the participants referred to it. Khalfhan et al. (2015:943) also identified dismissive attitudes, especially amongst contractors who had more experience in construction.

It is not straightforward to accurately identify the specific influences on human behaviour, but some insights from environmental psychology do shed some light. According to literature, behaviours can be influenced by "contextual forces, personal capabilities and habits" (Stern (2000) cited by Wilson & Rezgui (2013:291). Therefore, there are external factors that could play a contributing role. One of these factors indicated by participants 16, 21,23 and 24 related to how managers and supervisors on construction sites were sometimes harsh in how they address workers. This was perceived to breed a spiteful and resentful attitude amongst the workers, where they possibly disregarded or were dismissive of requirements as a way of retaliating against ill-treatment. Drawing from the discussion related to the focus of implementors being more on production, from the results there appeared to be more commitment to production because of the tangible value ascribed which was financial return. Participant 24 made an interesting comment that "people want to invest where they can get returns on." Therefore, it may be that some of the attitudes could be as a result of the suspected prevailing culture of focussing on profit.

Along similar lines of attempting to identify possible contributing factors to human behaviours, some of the other challenges that emerged from this research could also potentially play a role. In order to address such a challenge, it would be advisable to address the contextual factors that may influence implementors' attitudes and resultant behaviours. Human beings are predominantly autonomous, and so attempts to change their behaviour may not always be a short journey. At the core of the change is a person's openness and willingness to make the transition. According to Du Plessis (2007) cited by Abidin (2010:421), such changes do not only require commitment from individuals but should also satisfy what they deem as important. That being said, the value for the implementors of following environmental requirements would need to be better emphasised so that there is personal buy-in to drive implementation. Successful implementation of environmental requirements cannot be achieved without the implementors' buy-in toward a common goal.

c) Late integration of environmental requirements into project

As part of the theme of weak project integration, 58% of participants alluded that one of the challenges to implementation was associated with environmental requirements being incorporated late into the project. The result of this was often delays to construction progress and additional costs that had to be factored in.

Some of the issues revolved around environmental personnel being consulted later in the process, when work had already commenced, and areas that were missed in the EIA and other assessment phases are only identified during construction. A similar challenge also featured in reviewed literature, where 33% of articles where studies similar to this one was conducted referred to a "lack of integrated work environment and communication among all stakeholders". In the study conducted by Serpell et al. (2013:283), reference was made of designers who worked without involving the input of other stakeholders

At the core of this challenge category is planning inefficiencies, as well weak project stakeholder integration. The rationale behind integrated environmental management is that, at each stage or phase of the project-life cycle, all stakeholders' inputs are obtained and integrated. The concerns raised by participants associated with this category indicated that the different functions or professional expertise may not have been involved effectively from the earlier stages preceding construction. This contributes to a ''silo- effect" where the stages and activities are isolated from each other. Successful implementation of environmental requirements is highly dependent on what Arts and Faith-Ell (2012:3242) referred to as "Life-cycle integration" where all the stages are linked, from planning right through to operation, management and decommissioning. In order for this to work, the requisite knowledge, experience and expertise are required to inform activities related to planning, design, construction and the phases that follow (Wilson & Rezgui, 2013:303). In proposing possible remedies to the implication of gaps in the findings of the pre-construction environmental assessment activities, a few participants gave their insights on the matter.

Participants 17 and 21 indicated that environmental specialists should come on site before construction teams can commence work. During this time, the project area, whether the specific powerline route or substation location in this context, should be physically assessed. The purpose of this would be to identify and verify existing conditions against what were covered in the EIA or similar environmental assessment process. Then, should there be any additional requirements or processes to follow, these be attended to and finalised prior to a contractor being introduced.

This has direct relevance to another challenge that featured in the study relating to lack of review of historic environmental requirements. As participant 17 stated: "That's the small environmental issues we sometimes face with environmental impact studies that's been done 5 years ago and left, and now we start building and new things pop up". With a dynamic environment, it is far from ideal to rely on historic environmental assessments that may not be relevant to current conditions.

d) Poor visibility of environmental personnel

50% of participants expressed that one of the challenges they had was the limited presence and support of environmental personnel on construction sites. Environmental personnel in this case referred to environmental officers and experts in this field who have the qualification and knowledge to offer guidance on the requirements. Since the target audience for this study was non-environmental personnel, they felt they did not have the expertise or experience to effectively interpret and apply some of the details that were in the requirements. In order to bridge this gap, and for better assurance, participants felt that environmental site support staff need to be on site more frequently to offer guidance where needed. They felt they were often left to interpret and make sense of some of the requirements and application difficulties on their own,

The infrequent presence of environmental personnel was also considered to encourage non-conformance to requirements, as people on site may feel they can slack on following requirements due to inconsistent monitoring, as alluded by participants 21 and 24. The perception by some of the participants who raised this challenge was that environmental personnel seemed more interested in administration and fault-finding when on site instead of offering support. This non-supportive behaviour could contribute to workers having a negative perception towards not only the personnel, but possibly also resistance towards environmental requirements.

This particular challenge was not explicitly mentioned in the literature reviewed, but there was reference to a similar challenge of “lack of enforcement and monitoring” being cited as one of the barriers to low implementation by Abidin (2010:425).

The involvement of environmental personnel was considered crucial for effective implementation of requirements and the absence of these stakeholders undermines the objectives of sustainable construction. As candidly stated by participant 24 “It's not going to help the environment if the people monitoring the environment are not present”.

Environmental professionals can be regarded as the key custodians of the environmental requirements that need to be implemented. It is imperative that their visibility is evident, and their support felt by the people tasked with implementation. Based on the concerns raised about the compliance-driven nature experienced, a change of approach is warranted. In order for value to be added to the construction phase, focus should not only be on compliance and impact monitoring or evaluation against standards and expectations as aspects of follow-up practice (Morrison-Saunders & Arts, 2004:4-5; Marshall et al., 2005:176; Morrison-Saunders et al., 2007:1 and Pinto et al., 2019:2). The desire expressed by participants is to have environmental personnel engage with them and address the implementation challenges they may have. In this way, the management and communication element of follow-up are integrated, which could contribute towards better implementation for current and future projects.

e) Training challenges

The challenge of training, which formed part of the competency and capacity theme featured in the study, with 50% of the participants raising concerns about environmental training offered. The points related not so much to the lack of training on environmental requirements, but rather on the quality, content and approaches used during training interventions.

The strongest viewpoints expressed in this category related to training seemingly being compliance driven. Participants critiqued these interventions on lacking sufficient explanations, on not providing the reasons behind the establishment or rationale for the requirements. This was best captured in participant 6's comment when he elaborated that "If the training can explain why this wetland is important or what does it do in my daily life then it may change people's perceptions". The participants were more interested in understanding the "why" behind requirements instead of being threatened with legal compliance implications of not following environmental requirements.

This lack of understanding of environmental requirements was also reflected in responses to the Likert scale-based questions, where 75% of the participants agreed with it. It was interpreted from the responses that non-environmental professionals are generally aware of and possess some knowledge of the requirements but may not necessarily understand them. However, knowing about something did not guarantee application of that knowledge.

Wilson and Rezgui (2013) made a similar finding in this regard about the “lack of transference of knowledge into action” (Wison & Rezgui, 2013:296), where people may not understand the reasons behind having to apply that knowledge and therefore end up not applying it. This resonated with one of the key findings made by Aigbavboa et al. (2017:3008), where poor understanding of benefits was found to be one of the top two significant challenges highlighted in their studies. The findings of this study, where lack of understanding related to training was one of the prominent challenges, therefore aligns with the findings of the literature referenced here.

One of the recommendations to address this challenge is for the approach of environmental training to move away from enforcing compliance and rather foster “buy-in” from implementors. In order to do this, attention should focus on the role the requirements may play in managing impacts and the reasons or benefits of managing them. This may require more effort and research by facilitators to be informed about the science or reasoning behind certain requirements. For instance, instead of discouraging people from destroying a protected plant species from a legal non-compliance point of view, integrate the ecological function or value that specie may potentially hold. Secondly, as shared by participant 12, training should be extended from being classroom based to also include a practical component. By employing this strategy, non-environmental members can physically experience and observe in the field what is being referred to in theory

5.3 Recommendations for future research

One of the main challenges raised by non-environmental professionals related to not receiving sufficient support on site from the environmental personnel. It would be interesting for a study to be conducted aimed at getting perspectives from environmental professionals on this point. The research could focus specifically on those professionals who are appointed by developers of infrastructure projects and those who work for construction contractors appointed to build those developments. The objectives of such a study could be to explore what these stakeholders understand their role to be during the construction phase and what factors influence how often they are physically present at construction sites. The results of such research could be compared to what is expected by non-environmental implementors versus the perspectives of the environmental professionals.

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ANNEXURE A-RESEARCH BACKGROUND DOCUMENT

Research Unit for Environmental Sciences and Management

Mahlatsemoeng87@gmail.com

0791990679

Introduction to research study for potential participants

Research Topic: ***Challenges in implementing environmental requirements for construction of electricity infrastructure: Perspectives of non-environmental project team members***

(Ethics Number: NWU-01225-22-A9)

Dear potential participant

My name is Mahlatse Moeng, I'm a student enrolled with the North-West University undertaking studies towards obtaining a Masters degree in Environmental management. The following information is to provide you with information about my research and invite you to participate should you be willing to do so.

As part of my research course, I'm undertaking a study that focusses on exploring the challenges experienced in implementing environmental requirements in constructing electricity infrastructure. The purpose of the interview is to gather in-depth personal views and perspectives from *non-environmental project team members* involved in construction on their experiences in this regard. You were purposively identified as a potential participant because of your role and involvement in the construction of electricity infrastructure. The process that will be used to collect information will be in the form of interviews conducted by myself where questions will be asked of participants in line with the research topic. The interview duration can range from 30min to 45min.

Interview procedure

The interview procedure is as follows:

i) An interview date and time is agreed with the interviewee beforehand,

ii) The interview consent form is explained and signed before the interview commences

iii) The interview is recorded (audio only) and notes may be taken by the interviewer where necessary

iv) The interviewee will have the right to review the audio recording if they request so.

Confidentiality

The records from this interview will be kept confidential. No individual identities or affiliation to any specific company or institution will be used in any reports or publications resulting from the interview. All interview records will be given codes (e.g. Participant 1) and stored separately from any names or other direct identification of participants. The information obtained through the interview will be used exclusively for this research and for no other purpose.

Potential risks and compensation

No risks or discomforts are foreseen. In the event that a risk is identified, or discomfort is experienced by the interviewer, the interview will be stopped. You further have the right to withdraw from the interview at any time and for any reason. No compensation can be offered for participation in the interview.

Should there be any further questions or need for clarity please feel free to contact me on the above mentioned email address or cell number indicated at the top of this letter.

Yours sincerely

Mahlatse Moeng (Mrs)

ANNEXURE B-COPY OF INTERVIEW GUIDE

INTERVIEW GUIDE

Interviewee name: _____

Interviewee position: _____

Interview date: _____

Opening question:

a) Kindly explain your role/involvement in construction of electricity powerline projects

Core questions

Section A

1. To what extent are you aware of the environmental requirements related to your job/role?

2. What are the challenges you experience in implementing the environmental requirements in undertaking your work?

3. Why are those requirements challenging to implement?

4. What do you think can be done to resolve/address those challenges?

Section B

Please rate on a scale from 1-5 to what extent do you agree or disagree that these are challenges that you have experienced in implementing environmental requirements for construction of electricity infrastructure?

The points on the scale refers to the following response:

1= Strongly agree

2= Agree

3= Uncertain

4= Disagree

5- Strongly Disagree

Kindly rate/indicate your level of agreement for each statement and elaborate verbally on your choice of rating.

Question:

To what extent do you agree or disagree that these are challenges that you have experienced in implementing environmental requirements for construction of electricity infrastructure?

a) Lack of knowledge/awareness/education on environmental requirements
b) Concern of increased costs associated with implementing environmental requirements
c) Implementation causes delays to project progress
d) Requirements are impractical to implement
e) Stakeholders are not engaged or integrated in the earlier phases where requirements are determined
f) Lack of incentives to implement environmental requirements
g) Don't understand the benefit or value of following/implementing environmental requirements
h) Other requirements take priority over environmental management requirements in projects
i) Lack of support/resources to effectively implement requirements

Thank you for your participation in the interview

ANNEXURE C -COPY OF CONSENT FORM

Research Unit for Environmental Sciences and Management

Mahlatsemoeng87@gmail.com

0791990679

INTERVIEW CONSENT: Challenges in implementing environmental requirements for construction of electricity infrastructure: Perspectives of non-environmental project team members
(Ethics Number: NWU-01225-22-A9)

You are hereby invited to participate in an interview as part of a research project aimed at exploring the challenges experienced in implementing environmental requirements in constructing electricity infrastructure. The purpose of the interview is to gather in-depth personal views from non-environmental project team members on the challenges they experience in this regard. You were purposively selected as a participant because of your role and involvement in the construction of electricity infrastructure.

Interview procedure

The interview procedure is as follows: i) An interview date and time is agreed with the interviewee beforehand, ii) The interview consent form is explained and signed before the interview commences, iii) The interview is recorded (audio only) and notes may be taken iv) the interviewee will have the right to review the audio recording if they request so.

Confidentiality

The records from this interview will be kept confidential. No individual identities will be used in any reports or publications resulting from the interview. All transcripts will be given codes (e.g. Participant 1) and stored separately from any names or other direct identification of participants. The information obtained through the interview will be used exclusively for this research and for no other purpose.

Potential risks and compensation

No risks or discomforts are foreseen. In the event that a risk is identified, or discomfort is experienced, the interview will be stopped. You further have the right to withdraw from the interview at any time and for any reason. No compensation can be offered for participation in the interview.

INTERVIEWEE CONSENT

I _____ confirm that the above information was explained to me in a language and in manner that I understood. I further confirm that I am older than 18 years of age and hereby volunteer to take part in the research.

Signature_____Place_____Date_____

RESEARCHER CONFIRMATION

I _____ hereby confirm that the contents of this document was explained to the participant in a language and manner that he / she could understand.

Signature_____Place_____Date_____