

Construction Project Management Sustainability Competencies: Navigating Carbon Tax and Green Retrofitting Barriers from Corporations

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ABSTRACT

Introduced in 2019, South Africa's carbon tax imposes escalating financial penalties on companies exceeding emissions limits, reaching up to six billion rand annually. This study examines the perceived competencies of Construction Project Managers (CPMs) in green retrofitting against standards set by the Council for the Built Environment (CBE) and the South African Council for the Project and Construction Management Professions (SACPCMP) and develops Cognitive Competency Theory (CCT), testing its tenets in reality. The research employs qualitative methods, interviewing thirteen experienced CPMs in green refurbishment. Findings reveal that CPMs are pivotal in balancing carbon tax demands and advancing sustainable development. However, they often lack a full understanding of their role in environmental protection and compliance with carbon tax regulations. The study concludes that while CPMs are essential in navigating the complexities of green retrofitting, there is a need for future research to explore the evolving role of CPMs in relation to regulatory pressures and industry standards. The Centre for the Built Environment emphasises that CPMs must possess competencies across various stages of project development, but sustainability competencies are not yet standardised in the industry.

Keywords: Competency-Based Management; Green Retrofitting; Carbon Tax; Sustainable Development; Environmental Impact Assessment (EIA); Lifecycle Assessment (LCA).

1. INTRODUCTION

“Climate change is the defining crisis of our time, and we are at a defining moment”.
António Guterres

This statement by the United Nations Secretary-General António Guterres in 2019 encapsulates the urgency of addressing environmental issues. In South Africa, the introduction of a carbon tax in 2019 was promulgated to meet this concern and the current South African government has imposed financial penalties on companies exceeding emissions thresholds, amounting to over six billion rand annually (International Monetary Fund, 2023). While this regulatory measure aims to incentivise the greening process, Construction Project Managers (CPMs) in the construction and refurbishment sectors face significant barriers to implementing sustainable practices (Singh et al., 2020; Smith and Fischbacher, 2009). By exploring the perceived competencies of CPMs in green retrofitting against the South African Council for the Project and Construction Management Professions' (SACPCMP's) mandated sustainable development and environmental protection competencies, this study seeks to correlate the abilities of CPMs in South Africa to skilfully handle carbon tax reduction projects (SACPCMP, 2022; Sarkodie and Strezov, 2019; Venkataraman and Cheng, 2018). This interrelationship between perceived competencies and mandated competencies is a phenomenon that can be explained through the theory of Competency-Based Management (CBM), however, this theory needs to be complemented by Social Cognitive Theory (SCT) to fully encapsulate the observed phenomenon (Alfaiz et al., 2021; Barac, 2009; Locke, 1987). CBM is a strategic human resource management approach that focuses on using the competencies of employees as a way to achieve high organisational performance as posited by Sanchez, (2008) and Sanchez-Planelles et al., (2022). SCT will be tenanted to address the perceived competencies of CPMs in South Africa, encompassing their perceptions and perspectives on their own competencies in relation to those that have been mandated (Locke, 1987; SACPCMP, 2022; Zimmerman and Kitsantas, 2005). In the context of this study, CBM and SCT would need to be adapted to form a new theory and be applied to assess how well the perceived competencies of CPMs align with the mandated competencies set forth by the SACPCMP through the CBE (SACPCMP, 2022; Saunders et al., 2023; South African Government, 2017). This alignment is critical for achieving organisational goals related to sustainability and compliance with carbon tax regulations in South Africa (Chien et al., 2021; Hagmann et al., 2019; International Monetary Fund, 2023; Tao et al., 2021).

1.1 Background

1.1.1 Validating CPM Competencies for Sustainable Retrofitting

The focus on '*perceived competencies*' also introduces an element of SCT, which posits that learning occurs in a social context and that individuals are both influenced by, and exert influence over, their environment further affirming the need for Masterclasses through the legislated practices and governing bodies of South Africa (Barac, 2009; Bredenoord et al., 2020; Locke, 1987; Mee-Ngoen et al., 2020; Ramos, 2020). Pertaining to the case at hand, CPMs' self-perception of their competencies can impact their ability to effectively implement green retrofitting projects (Ayoade and Ahmed, 2020; Crawford, 2005). The construction industry, particularly in the realm of project management, has been slow to adopt sustainable practices, often due to a lack of understanding or

awareness of the benefits and technologies available for green retrofitting (Matar et al., 2008). This study aims to fill this gap by validating the competencies of CPMs in South Africa, thereby contributing to the larger discourse on sustainable development and environmental protection (Elkington, 1998).

1.1.2 CPM Competencies in Green Retrofitting and Carbon Taxation

A significant gap in literature exists pertaining to the competencies of South African CPMs in the context of green retrofitting and carbon taxation (Crawford et al., 2006; Silvius and Schipper, 2014). While some may argue that focusing on CPMs' competencies is too narrow and that systemic changes are more crucial for sustainable development (Aarseth et al., 2017). The role of CPMs in navigating complex regulatory landscapes cannot be overlooked (Abidin and Powmya, 2014; Crawford, 2005; Matar et al., 2008; Mulliner and Maliene, 2015; Shooshtarian et al., 2021; Weaich et al., 2023). Existing literature largely focuses on sustainable practices and technologies but falls short in examining the specific competencies required by CPMs to effectively implement green retrofitting in the face of carbon taxation (Kibert, 2016; Müller et al., 2013). This study fills this gap in knowledge by employing qualitative methodologies to validate CPMs' perceived competencies against the SACPCMP's mandated competencies (Smith and Fischbacher, 2009). The cost of not addressing this gap could result in inefficient green retrofitting projects, implemented untested through theory and further misalignment of sustainable development goals, leading to increased carbon emissions and further financial penalties (Shen et al., 2010). Contribution to the larger discourse on sustainable development by focusing on the competencies of CPMs in South Africa is an imperative that must be elucidated on and resolved (Elkington, 1998).

1.2 Research Gap

The research gap identified in this study is centred on the limited understanding of Construction Project Managers' (CPMs) competencies in green retrofitting within the global context, particularly in the face of evolving carbon taxation and sustainable development regulations. Despite the critical role that CPMs play in navigating these complexities, existing literature has predominantly focused on specific project management disciplines in South Africa and has not extensively explored the impact of emerging technologies or the quantitative prevalence of specific competencies in this particular geographic locale (Kibert, 2016; Müller et al., 2015). Through addressing these areas, the study significantly contributes to the body of knowledge on sustainable construction project management by offering a construction project managers perspective, integrating technological advancements through the principle of green retrofitting into the competency frameworks, and providing a cross-sectional view of competency evolution in response to external pressures (Hussain et al., 2023; Mee-Ngoen et al., 2020; Mushi et al., 2022; Olawumi et al., 2023; Singh et al., 2020).

1.3 Aim

The aim of this study is to critically evaluate the competencies of Construction Project Managers (CPMs) in South Africa for green retrofitting initiatives within the construction industry, with a specific focus on identifying and enhancing these competencies to effectively reduce carbon tax liabilities, guided by the principles of Cognitive Competency Theory (CCT). This investigation seeks to contribute to the broader discourse on sustainable development by providing actionable insights into the alignment of CPMs' perceived competencies with mandated standards, thereby contributing to both academia

and practice by identifying the barriers to sustainable practice implementation, and the potential for competency enhancement through targeted professional development, thereby addressing the challenges and opportunities presented by green retrofitting and carbon taxation within the dynamic South African construction sector (Crawford et al., 2006; Silvius and Schipper, 2014).

1.4 Main Research Question (MRQ)

Based on the comprehensive introduction and background provided in the study above, the multifaceted research question is as follows:

MRQ: How do the perceived competencies of CPMs in South Africa align with the SACPCMP's mandated competencies for green retrofitting projects, and what are the implications of this alignment for overcoming barriers to sustainable practices within the context of carbon taxation and environmental regulations?

This research question integrates the core aspects of the study: the examination of CPMs' competencies, the alignment with mandated competencies, the impact of this alignment on the implementation of sustainable retrofitting projects, and the broader context of carbon taxation and environmental sustainability. It also encompasses the theoretical framework of CBM and SCT, offering a pathway to explore both the individual perceptions of competencies and their societal and regulatory implications.

1.5 Sub-Questions (SQ)

The multifaceted research question (**MRQ**) has been delineated into three sub-questions to explore the various dimensions of the study in detail:

SQ1: How do CPMs in South Africa perceive their competencies in relation to the SACPCMP's mandated competencies for green retrofitting, and what factors influence these perceptions?

SQ2: What are the significant barriers that Construction Project Managers (CPMs) face in implementing sustainable retrofitting practices in the context of South African carbon taxation and environmental regulations?

SQ3: What are the implications of the alignment between perceived and mandated competencies of CPMs for sustainable retrofitting projects' success and compliance with carbon tax regulations in South Africa?

These sub-questions collectively provide a comprehensive understanding of the competencies of Construction Project Managers in the context of green retrofitting, identifying the gaps and opportunities for enhancing sustainable practices within the South African construction industry.

1.6 Objectives (O)

Based on the delineated multifaceted research question, the objectives of the study have been structured to systematically address each sub-question and contribute to achieving the overall aim of validating the competencies of Construction Project Managers (CPMs) in South Africa for green retrofitting against the SACPCMP's mandated competencies. The objectives corresponding to each sub-question are as follows:

O1: To evaluate the self-perceived competencies of CPMs in green retrofitting projects within the South African construction industry and identify the key factors that influence these perceptions, including educational background, professional experience, and awareness of sustainable practices.

O2: To identify the primary barriers faced by CPMs in implementing sustainable retrofitting practices in South Africa and analyse these barriers in the context of carbon taxation and environmental regulations.

O3: To investigate the implications of the alignment between CPMs' perceived competencies and the SACPCMP's mandated competencies on the success of green retrofitting projects and adherence to carbon tax regulations.

Together, these objectives guide the research in exploring the complexities of competency alignment among Construction Project Managers in South Africa, addressing the barriers to sustainable construction practices, and ultimately contributing to the enhancement of green retrofitting projects within the framework of carbon taxation and environmental sustainability.

1.7 Assumptions (A)

As the study is focused on evaluating the competencies of Construction Project Managers (CPMs) in South Africa for green retrofitting against the SACPCMP's mandated competencies, several underlying assumptions must be acknowledged. These assumptions are integral to the framing of the research and its subsequent methodology, analysis, and interpretation. They correspond to the objectives and sub-questions previously outlined:

A1: It is assumed that there is a clear and uniform understanding among CPMs and the SACPCMP regarding what constitutes the necessary competencies for green retrofitting. This includes technical skills, knowledge of sustainable practices, and the ability to navigate carbon tax regulations and other environmental guidelines.

A2: The study assumes that sustainable retrofitting practices are accessible and relevant to the South African construction industry and that CPMs are aware of these practices. This includes the availability of green technologies, materials, and the feasibility of implementing such practices within current projects and pre-existing structures.

A3: It is assumed that the alignment between CPMs' perceived competencies and the SACPCMP's mandated competencies has a direct impact on the success of green retrofitting projects and compliance with carbon tax regulations. This implies that greater alignment would lead to more successful project outcomes and better adherence to environmental regulations.

These assumptions serve as the foundational beliefs upon which the study is constructed, guiding the research design, data collection, and analysis processes. They are critical for understanding the context of the study and interpreting its findings within the specific landscape of sustainable construction practices in South Africa.

1.8 Hypotheses (H)

Based on the research objectives and the assumptions outlined for the study on Construction Project Managers' (CPMs) competencies in green retrofitting within the South African context, hypotheses have been formulated to provide a basis for empirical testing. These hypotheses correspond to the objectives targeted at evaluating the alignment between perceived and mandated competencies, identifying barriers to sustainable practices, and exploring the implications of competency alignment on project success and compliance with carbon tax regulations, they are as follows:

H1: There is a significant alignment between the self-perceived competencies of CPMs in South Africa and the SACPCMP's mandated competencies for green retrofitting.

H2: Significant barriers exist that prevent CPMs in South Africa from implementing sustainable retrofitting practices, influenced by factors such as regulatory challenges, financial constraints, and lack of awareness or technical knowledge.

H3: The degree of alignment between CPMs' perceived competencies and the SACPCMP's mandated competencies positively affects the success of green retrofitting projects and compliance with carbon tax regulations.

These hypotheses provide a structured approach for investigating the key aspects of the study, facilitating empirical examination, and contributing to the understanding of how competency alignment, barriers to sustainability, and their implications affect the construction industry's move towards greener practices in South Africa.

2. LITERATURE REVIEW

2.1 Theoretical Literature Review

2.2.1 Social Cognitive Theory and Self-Perception

Social Cognitive Theory (SCT) posits that individuals learn within a social context and are influenced by their environment (Locke, 1987). Resulting in the need for Masterclasses and Continued Professional Development (CPD). Internationally, SCT has been applied to understand self-efficacy and performance in project management (Zimmerman and Kitsantas, 2005). There is limited research on how CPMs' self-perception of their competencies affects their performance in green retrofitting projects (Smith and Fischbacher, 2009). By exploring CPMs' self-perception of their competencies in green retrofitting, thereby contributes to SCT literature. In retrospect, existing studies often focus on self-efficacy but neglect how self-perception aligns with CPMs mandated competencies (Aarseth et al., 2017).

2.2.2 Competency-Based Management in Project Management

Internationally, the theory of Competency-Based Management (CBM) has been applied to various fields, including project management (Sanchez, 2008; Sanchez-Planelles et al., 2022). CBM focuses on aligning employees' competencies with organisational goals (Boyatzis, 1982). In the context of project management, competencies are often categorised into technical, behavioural, and contextual (Crawford, 2005). While CBM is well-studied, its application in the realm of green retrofitting and sustainability within project management is less explored (Silvius and Schipper, 2014). By adapting CBM theory to focus on Construction Project Managers' (CPMs) competencies in green retrofitting, particularly in the South African context offers a new incite to explaining this phenomenon.

Previous studies often overlook the pressures of regulatory frameworks like carbon taxation on competency requirements (Müller et al., 2013).

2.2 Empirical Literature Review

2.2.1 Defining the CPM in South Africa

In South Africa, a Construction Project Manager (CPM) plays a pivotal role in the construction industry, overseeing the planning, coordination, and execution of construction projects from inception to completion. This role is critical for ensuring that projects are completed on time, within budget, and according to specified quality standards, while also meeting the legal, safety, and environmental requirements specific to the South African context (SACPCMP, 2022).

The primary responsibilities of a CPM in South Africa encompass a broad range of tasks, including but not limited to:

Project planning and design which involves the initial conceptualisation of the project, including feasibility studies and design management in collaboration with architects and engineers (Walker, 1989). Aspects of cost management which entails budget estimation, cost control, and financial reporting to ensure the project remains within the financial constraints (du Plessis and Oosthuizen, 2018). The key aspect of time management which includes scheduling, timeline setting, and ensuring that the project progresses according to the planned schedule to avoid delays (Howes et al., 2017). The monitoring of quality management which ensures that the construction project meets the specified standards and complies with legal and regulatory requirements specific to South Africa (South African Government, 2017). The management of contract administration which involves managing contracts with subcontractors, suppliers, and other stakeholders, ensuring that all contractual obligations are met (du Plessis and Oosthuizen, 2018). Site safety management which ensures compliance with South Africa's stringent health and safety regulations to prevent accidents and injuries on-site (South African Government, 1993). Most importantly stakeholder communication which involves effective communication with all stakeholders, including clients, contractors, government authorities, and the community, to ensure the smooth progress of the project (Molwus, 2014; Ndlovu and Simbanegavi, 2023).

2.2.2 South African CPMs have a Regulatory Framework

In South Africa, the role of a CPM is regulated by several statutory bodies and frameworks, including the South African Council for the Project and Construction Management Professions (SACPCMP), which sets the standards for registration and practice in the profession. The Construction Industry Development Board (CIDB) also plays a crucial role in grading and registering construction entities to promote growth, development, and best practices within the industry.

CPMs in South Africa face unique challenges, such as navigating the complexities of local regulations, dealing with the challenges of project financing in a fluctuating economic environment, and addressing the skills gap within the construction workforce (CIDB, 2018). Moreover, the socio-economic context, including issues related to affordable housing and sustainable development, places additional demands on the role, requiring a balance between commercial objectives and social responsibility. CPMs in South Africa is a multi-faceted professional role that requires a blend of technical expertise, leadership, and strategic thinking. The effectiveness of a CPM in navigating the complex landscape of

South African construction projects significantly influences the successful delivery of these projects, contributing to the socio-economic development of the country.

2.2.3 Regulatory Frameworks and Internationally Framed Project Management

Internationally, the role of regulatory frameworks like carbon taxation in influencing project management decisions has been studied (Shen et al., 2010). These frameworks often act as external motivators for adopting sustainable practices (Elkington, 1998). There is a lack of research on how South African CPMs navigate the complexities of carbon taxation in green retrofitting (Kibert, 2016). By exploring the impact of carbon tax regulations on CPMs' decision-making processes in South Africa, new insights and solutions have been discovered. Previous studies often focus on the impact of regulations but do not delve into how CPMs adapt their competencies to meet these challenges (Matar et al., 2008).

The literature reveals that by understanding the competencies required by CPMs in green retrofitting, particularly in the South African context, will result in the accelerated adoption of green retrofitting of buildings and the mitigation of carbon taxation on businesses. This study fills these gaps by extending theories of CBM and SCT outside of their original ambit to explore CPMs' competencies and self-perceptions in navigating regulatory frameworks like carbon taxation and the benefits of green retrofitting.

2.2.4 CPMs' Competencies in Green Retrofitting and Carbon Taxation

Critical analysis of existing literature reveals that while there are mandated competencies for CPMs, there is a disconnect between the mandated competencies and the actual practices on the ground (Crawford et al., 2006; He et al., 2018; Hussain et al., 2023; Mee-Ngoen et al., 2020; Olawumi et al., 2023; Sarkodie and Strezov, 2019; Kamanda, 2023). The complexities surrounding carbon tax and the retrofitting of buildings require a multi-faceted approach, involving not just technical skills but also a deep understanding of sustainability (Silvius and Schipper, 2014; Zhang and He, 2022). The field of sustainable development in the construction industry has garnered significant attention in recent years, particularly due to its potential to mitigate the adverse effects of climate change (Kibert, 2016; Shen et al., 2010). Within this broader subject area, by addressing the specific issue of Construction Project Managers' (CPMs) competencies in green retrofitting against the SACPCMP's mandated competencies further insight is provided. This problem is of considerable significance as CPMs play a pivotal role in navigating the complexities of carbon taxation and sustainable development (Crawford et al., 2006; Silvius and Schipper, 2014). The current status of the problem reveals that while there have been advancements in green technologies and practices, the adoption rate among CPMs remains low (Matar et al., 2008; Smith and Fischbacher, 2009). Previous studies have employed various methodologies, including qualitative interviews and surveys, to explore the barriers to sustainable practices in project management (Aarseth et al., 2017; Müller et al., 2013). However, these studies often lack a focus on the South African context and the implications of carbon tax regulations (Elkington, 1998; Shen et al., 2010).

A critical review of the indicates that while there are comprehensive studies on sustainable development and project management, there is a gap in research focusing on CPMs' competencies in the context of green retrofitting and carbon taxation (Aarseth et al., 2017; Fuertes et al., 2020; Hamida et al., 2022; Kibert, 2016; Müller et al., 2013; Silvius and Schipper, 2014). Therefore, this study fills this research gap by examining the perceived competencies of CPMs in South Africa, thereby contributing to the larger discourse on sustainable development and environmental protection (Aarseth et al., 2017; Elkington, 1998).

2.2.5 The Development of Cognitive Competency Theory (CCT)

To establish a theoretical foundation that combines the concepts of Social Cognitive Theory (SCT) and Competency-Based Management (CBM) into a cohesive framework, the study proposes the development of a new theory titled Cognitive Competency Theory (CCT), for which it will test for such a theory in reality. This framework seeks to integrate the individual cognitive aspects of project management competencies with the structural, competency-based approach to managing and implementing sustainable practices within the construction industry, especially in the context of green retrofitting and navigating carbon taxation.

2.3 Theoretical Foundation of Cognitive Competency Theory (CCT)

2.3.1 Integration of SCT and CBM

SCT and CBM theory posits that the successful implementation of sustainable retrofitting projects requires not only the alignment of Construction Project Managers' (CPMs) competencies with organisational goals (as suggested by CBM) but also considers the individual's self-perception, self-efficacy, and social influences (central to SCT). This dual focus acknowledges the importance of both individual cognitive processes and organisational competency frameworks in achieving sustainable project outcomes (Boyatzis, 1982; Locke, 1987).

2.3.2 Self-Perception and Competency Alignment

Drawing from SCT, the CCT emphasises the role of CPMs' self-perception in determining their effectiveness in green retrofitting projects. It suggests that CPMs' beliefs about their competencies significantly impact their ability to meet the SACPCMP's mandated competencies and effectively navigate the complexities of carbon taxation and sustainability requirements (Locke, 1987).

2.3.2 Competency Development and Sustainability

From the CBM perspective, the CCT underlines the need for continuous professional development (CPD) and masterclasses targeted at enhancing CPMs' competencies in sustainable practices. This approach aligns with the organisational goal of fostering a workforce capable of meeting the challenges posed by carbon taxation and the demand for green retrofitting (Boyatzis, 1982).

2.3.3 Adaptive Competency Framework

CCT advocates for an adaptive competency framework that responds to the evolving landscape of sustainability and regulatory requirements. This framework should integrate technical, behavioural, and contextual competencies, with a strong emphasis on sustainability-oriented skills and knowledge (Ndlovu and Simbanegavi, 2023).

2.3.4 Regulatory Frameworks and Cognitive Adaptation

Reflecting on the empirical literature review, the CCT acknowledges the influence of external regulatory frameworks (like carbon taxation) on project management decisions. It proposes that CPMs' cognitive adaptation to these frameworks, facilitated by an understanding of SCT and supported by CBM principles, is essential for the successful implementation of sustainable practices.

The Competency and Cognitive Framework for Sustainable Project Management offers a comprehensive theoretical foundation that bridges the gap between individual cognitive factors and organisational competency requirements. By integrating SCT and CBM, CCT provides a nuanced understanding of the competencies necessary for CPMs to effectively manage green retrofitting projects in the face of carbon taxation and sustainability challenges. This new theory encourages a holistic approach to competency development, emphasising the importance of both individual perceptions and organisational strategies in achieving sustainable project management outcomes.

3. THEORETICAL FRAMEWORK

3.1 Cognitive Competency Theory (CCT)

Cognitive Competency Theory (CCT) as developed for the empirical testing in this study to meet its objectives in formulating a set of subjective proofs provides a concise and impactful method that encapsulates the essence of integrating cognitive and competency-based approaches in project management, specifically within the context of sustainability and green retrofitting. CCT will enhance understanding and application in the construction industry by focusing on the interplay between individual cognitive processes and the structured management of competencies. Cognitive Competency Theory (CCT) posits that the efficacy of Construction Project Managers (CPMs) in implementing sustainable retrofitting practices is significantly influenced by a synergistic relationship between their cognitive perceptions (including self-efficacy, outcome expectations, and personal agency) and their professional competencies (technical, behavioural, and contextual skills aligned with organisational goals). The CCT framework emphasises the importance of both these elements in achieving sustainable outcomes in construction projects, particularly under the pressures of carbon taxation and environmental regulations.

3.2 Key Elements (Tenets) of CCT

3.2.1 Cognitive Processes in Competency Perception

CCT underscores the role of CPMs' self-perception and cognitive processes in understanding and aligning their competencies with the mandated standards for green retrofitting. This aspect draws heavily from Social Cognitive Theory, highlighting the impact of self-efficacy and social learning on competency development and application (Locke, 1987).

3.2.3 Competency Alignment and Sustainability

Reflecting principles from Competency-Based Management, CCT stresses the alignment of CPMs' competencies with the broader organisational and societal goals of sustainable development. It advocates for a comprehensive competency framework that encompasses the skills needed to navigate the intricacies of sustainable project management, including adherence to environmental regulations (Boyatzis, 1982).

3.2.4 Continuous Professional Development (CPD)

CCT calls for ongoing CPD initiatives focused on enhancing CPMs' understanding of sustainable practices, green technologies, and regulatory compliance. These initiatives are seen as crucial for maintaining and expanding the competencies required for successful green retrofitting projects.

3.2.5 Adaptability to Regulatory Changes

Recognising the dynamic nature of environmental regulations and carbon taxation policies, CCT emphasises the need for CPMs to adapt their competencies in response to these external pressures. This adaptability is facilitated through a strong foundation in cognitive flexibility and learning agility.

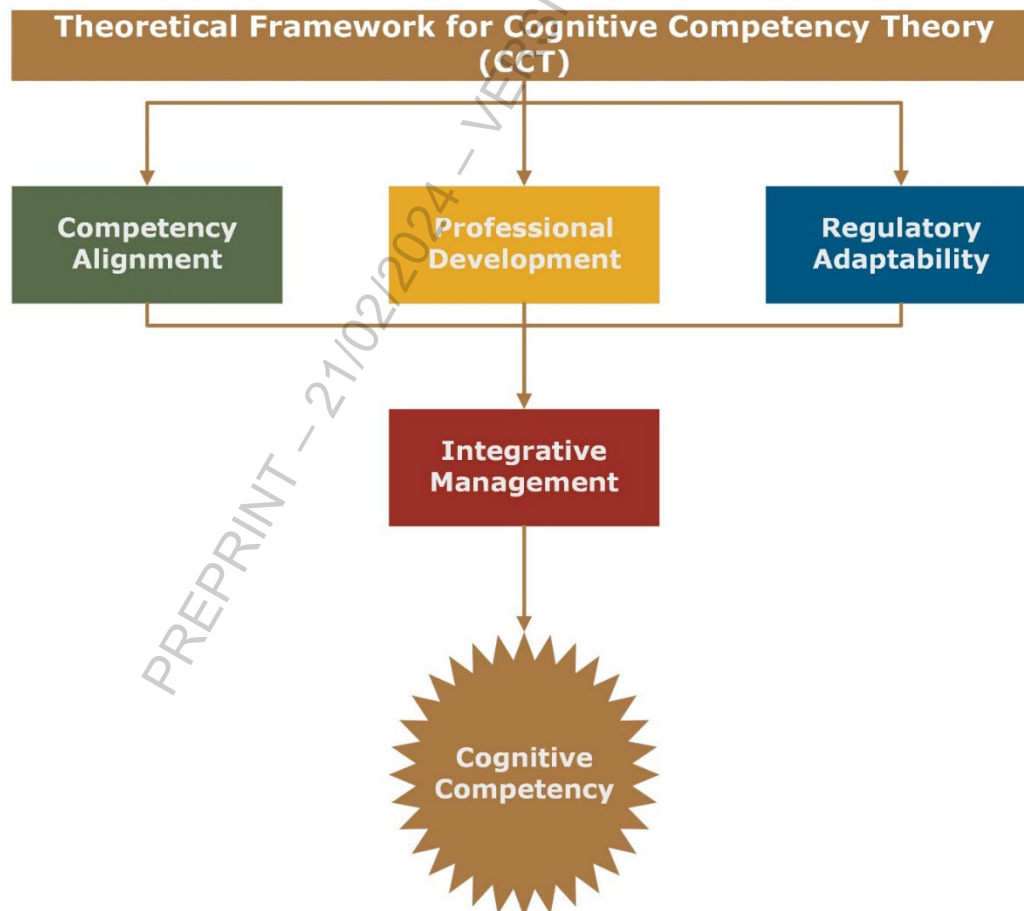
3.2.6 Integrative Approach to Project Management

CCT advocates for an integrative approach to project management that combines cognitive insights with competency-based strategies. This approach ensures that CPMs are not only technically equipped but also cognitively prepared to lead sustainable retrofitting projects effectively.

3.2.7 Visualising Cognitive Competency Theory (CCT)

Cognitive Competency Theory (CCT) offers a robust theoretical framework that bridges individual cognitive attributes with the practical demands of competency management in the realm of sustainable development. By focusing on the cognitive and competency aspects of project management, CCT provides a comprehensive perspective on how CPMs can navigate the challenges and opportunities presented by green retrofitting and carbon taxation, thereby contributing to the larger goal of sustainable development within the construction industry.

Figure 1: Theoretical Framework for Cognitive Competency Theory (CCT)



4. METHODOLOGY

4.1 Methodological Rigour in CPM Competency Research

In accordance with Saunders et al., (2023) Research Onion, this study meticulously outlines its methodology, ensuring a rigorous academic approach to exploring the competencies of Construction Project Managers (CPMs) in the context of green retrofitting within South Africa. At the outermost layer, the study is anchored in an interpretivist philosophy, acknowledging the complexity of subjective experiences and the nuanced perceptions of CPMs. This philosophical stance underpins the qualitative and inductive research approach employed, which is dedicated to generating insightful concepts from the empirical data gathered, thereby enriching existing theoretical frameworks (Bryman, 2016; Creswell and Creswell, 2017). Progressing inward, the choice of research strategies and methods is carefully tailored to the interpretivist foundation. The study is conducted within the urban centres of Johannesburg, Cape Town, and Durban—areas recognised for their pivotal role in the construction industry and as hubs for businesses impacted by carbon taxation, allowing for a study which encapsulates the urban landscape of a counties population as posited by Weeks, (2010). This geographical focus ensures the relevance and contextual richness of the data collected. Semi-structured interviews are identified as the primary method for data collection. This technique is chosen for its flexibility and depth, allowing for a comprehensive exploration of CPMs' perceptions and experiences while enabling respondents to express their views in their own terms. Such an approach is instrumental in capturing the intricate details of competency perceptions and the challenges faced in sustainable project management practices and is an advocated empirical form of scientific enquiry to form theory (Deb et al., 2019; Melnikovas, 2018; Saunders et al., 2023; Thomas, 2021). For data analysis, the study employs thematic analysis, utilising thematic software to systematically categorise and interpret the data. This analytical method aligns with the study's qualitative and inductive approach, facilitating the identification of patterns and themes that emerge from the interviews. Through thematic analysis, the study uncovers the underlying factors influencing CPMs' competency alignments, their adaptability to regulatory changes, and their approaches to integrating sustainability into project management and in doing so forms the core tenets of Cognitive Competency Theory (CCT) for which it successfully observes and studies a phenomenon for theoretical exploration and scientific discovery. This methodology section structured around Saunders et al., (2023) Research Onion, presents a coherent and comprehensive framework for investigating the competencies of Construction Project Managers in the realm of green retrofitting within the South African context. By delving into the subjective experiences of CPMs and analysing these through a rigorous qualitative lens, the study aspires to contribute valuable insights to the field of sustainable construction management and the broader discourse on sustainable development.

5. DATA

5.1 Sample Profile in CPM Study

The initial sample size comprised of 30 CPMs that were invited to be interviewed, but only 13 responded and were interviewed.

Table 1: Profile of Participants

Participant Code	Discipline	Experience	Location
A	Construction Project Manager	10 years	Johannesburg
B	Construction Project Manager	25 years	Johannesburg
C	Construction Project Manager	5 years	Johannesburg
D	Construction Project Manager	12 years	Durban
E	Construction Project Manager	8 years	Johannesburg
F	Construction Project Manager	23 years	Durban
G	Construction Project Manager	18 years	Cape Town
H	Construction Project Manager	11 years	Cape Town
I	Construction Project Manager	10 years	Durban
J	Construction Project Manager	16 years	Durban
K	Construction Project Manager	15 years	Cape Town
L	Construction Project Manager	27 years	Cape Town
M	Construction Project Manager	16 years	Johannesburg

5.2 Variables in CPM Competency Research

The studies variables include CPMs' perceived competencies in sustainable practices and their understanding of carbon tax regulations. Each variable is operationally defined to ensure clarity. The chosen methodology aligns well with the research objectives, offering nuanced insights into CPMs' competencies and challenges in green retrofitting (Yin, 2018). The study focuses on CPMs' willingness to adopt sustainable practices, with a broader scope of understanding the impact of carbon tax regulations on sustainable development in the construction industry, underscoring the necessity of advancing both professional competencies and end-user engagement to foster sustainable development within South Africa's construction industry (Kibert, 2016; Weaich et al., 2023).

5.3 Rigorous Protocol and CPM Competency Insights

The study employed a rigorous interview protocol, ensuring that the research is replicable (Given, 2008). In summary, this study successfully endeavours to understand the competencies and challenges faced by CPMs in South Africa in the context of green retrofitting and carbon taxation, thereby contributing to the larger discourse on sustainable development (Aarseth et al., 2017).

6. RESULTS

6.1 Required Competencies of CPM's (RCs)

The study's findings indicate that Construction Project Managers (CPMs) necessitate additional competencies to remain both competitive and relevant in the execution of green

retrofitting projects aimed at minimising carbon tax liabilities. These findings are systematically categorised under five principled themes, Knowledge of Sustainability, Skills in Environmental Assessment, Compliance with Environmental Regulations, Resource optimisation, and Technical Expertise.

6.2.1 RC1: Sustainability Knowledge in Construction Project Management

The research findings underscore the imperative for Construction Project Managers (CPMs) to have a robust foundation in sustainability knowledge to effectively implement sustainable practices within construction projects. This foundational knowledge encompasses proficiency in green building certifications and strict adherence to established environmental standards. Participant G asserted, *"Having a strong foundation in sustainability knowledge is crucial for construction project managers. Without expertise in green building certifications and a deep understanding of energy efficiency, it's challenging to drive sustainable practices."* Similarly, Participant C emphasised the importance of *"integrating renewable energy sources and selecting environmentally friendly materials throughout the entire project lifecycle."* The findings accentuate that a nuanced understanding of energy efficiency principles, along with the capability to integrate renewable energy sources seamlessly, is pivotal. Additionally, CPMs are expected to exhibit expertise in the selection of construction materials that are congruent with sustainability objectives, thereby reinforcing the significance of making environmentally responsible choices throughout the project's lifecycle.

6.2.3 RC2: Environmental Assessment and Environmental Compliance

The study delineates essential competencies required by Construction Project Managers (CPMs) for the effective management of green retrofitting projects aimed at carbon tax reduction. Participant E emphasised, *"Environmental assessment and compliance are the backbone of successful green retrofitting. It's not merely about sustainability knowledge; construction project managers must be proficient in conducting carbon footprint assessments and maintaining regulatory compliance. This ensures that our projects not only meet environmental standards but also make an active contribution to carbon emission reduction."* In a similar vein, Participant J noted, *"Striking a balance that ensures compliance without compromising project efficiency and timelines is preferable to prioritising competencies over compliance."* These competencies are multifaceted, encompassing a strong foundation in sustainability knowledge, which includes expertise in green building certifications, energy efficiency, renewable energy integration, and sustainable material selection. Furthermore, CPMs are expected to excel in conducting carbon footprint assessments, thereby demonstrating their ability to measure and mitigate the environmental impact of construction activities. The study also underscores the importance of regulatory compliance awareness, emphasising the need for CPMs to stay abreast of environmental regulations to ensure that projects align with carbon emission standards. Collectively, these competencies enable CPMs to navigate the intricacies of green retrofitting effectively, thereby making a significant contribution to carbon reduction objectives.

6.2.4 RC3: Waste Management Competencies in Green Retrofitting

The findings accentuate the significance of waste reduction and recycling as pivotal competencies for Construction Project Managers (CPMs) in the realm of green retrofitting projects, particularly those aimed at carbon tax mitigation. Participant M articulated, *"By minimising construction waste and advocating for recycling, we not only adhere to a more environmentally responsible approach but also actively advance towards the overarching*

objective of carbon footprint reduction." Unanimously, all participants concurred that CPMs must be skilled in implementing efficacious waste management strategies. This includes the minimisation of construction waste and the promotion of recycling practices. Such a focus on resource optimisation is congruent with broader sustainability objectives, thereby fostering a more environmentally responsible approach to construction and buttressing the ultimate goal of reducing carbon emissions.

6.2.5 RC4: Technical Competencies in Sustainable Retrofitting

The study delineates technical competencies as indispensable for Construction Project Managers (CPMs) engaged in green retrofitting initiatives aimed at carbon tax reduction. Participants C, D, and G observed, *"Understanding building systems is essential for optimising energy efficiency and for monitoring post-retrofitting energy performance, as this ensures a sustained reduction in environmental impact."* This entails a nuanced understanding of building systems, facilitating effective optimisation of energy efficiency. CPMs are also expected to possess the capability to monitor and improve energy performance following retrofitting activities, thereby ensuring a lasting reduction in environmental impact. The study accentuates the importance of interdisciplinary collaboration, particularly with experts in energy efficiency and environmental engineering, for the successful implementation of green retrofitting measures. Collectively, these technical competencies empower CPMs to navigate the intricacies of sustainable construction practices, thereby making a substantial contribution to carbon reduction efforts. Participant L further noted, *"Collaborating with experts in areas like energy efficiency is crucial; it provides a holistic perspective on sustainability."*

6.3 CPM Green Retrofitting Barriers to Reduce Carbon Tax (BPs)

6.3.1 BP1: Financial Constraints in Green Retrofitting

The study delineates that 90% of Construction Project Managers (CPMs) identify financial constraints, particularly the upfront costs associated with the adoption of eco-friendly technologies and materials, as a significant impediment to the implementation of green retrofitting projects. Participant B, D, and L articulated, *"The substantial upfront costs for environmentally friendly technologies frequently serve as a major obstacle."* Participants G and M elaborated, *"There is a pressing need for pragmatic solutions, possibly augmented by financial incentives or support, to surmount this financial barrier and facilitate the broader adoption of sustainable practices in the construction sector."* Additionally, Participant H posited, *"The long-term economic benefits and cost savings derived from sustainable practices could potentially offset the initial financial outlay. The challenge lies more in altering prevailing mindsets and establishing the economic feasibility of green retrofitting."*

6.3.2 BP2: Barriers to Green Retrofitting Adoption

The study reveals that a paucity of awareness and comprehension of green retrofitting practices among key stakeholders—such as clients and team members—creates obstacles in effective communication and collaboration. This is further exacerbated by the absence of standardised regulations and incentives, which impedes the broad adoption of green retrofitting initiatives. Inertia within conventional construction methodologies and a hesitancy to invest in innovative technologies also manifest as significant barriers. The research accentuates the imperative for specialised educational programs, fiscal incentives, and coherent regulatory frameworks to surmount these challenges and enable the successful assimilation of green retrofitting practices within the construction industry.

Participant E corroborated this by stating, *"Communicating the advantages of green retrofitting becomes particularly challenging when stakeholders lack proficiency in sustainable technologies. The absence of standardized regulations and incentives adds another layer of complexity. In my view, targeted educational initiatives, coupled with financial incentives and well-defined regulatory frameworks, are indispensable for overcoming these barriers and encouraging a more universal adoption of green retrofitting practices."*

6.4 Potential Contribution by CPMs to Reduce Carbon Tax (PCs)

The study underscores the instrumental role that Construction Project Managers (CPMs) can play in mitigating carbon tax through the effective implementation of green retrofitting. CPMs are central to the strategic integration of sustainable practices in construction projects, including the adoption of energy-efficient designs, the selection of eco-friendly materials, and the incorporation of renewable energy sources.

Their expertise in conducting exhaustive carbon footprint assessments and compliance with regulatory standards ensures alignment with carbon reduction objectives. Furthermore, CPMs are adept at facilitating robust communication and collaboration among stakeholders, thereby cultivating a sustainability-oriented culture. Through the optimisation of building systems, vigilant monitoring of energy performance, and engagement with subject-matter experts, CPMs make a substantial contribution to environmental impact minimisation. Ultimately, the comprehensive approach and leadership exhibited by CPMs in green retrofitting projects have the potential to yield measurable reductions in carbon emissions, thus aligning with wider efforts to address climate change. Participant I emphasised, *"CPMs are at the vanguard of incorporating energy-efficient designs and nurturing a sustainability-centric culture. Their comprehensive, holistic approach, which includes in-depth assessments and stakeholder collaboration, can unquestionably lead to tangible carbon emission reductions, thereby aligning with larger-scale initiatives to combat climate change."*

7. DISCUSSION

7.1 CPM Competencies for Green Retrofitting Success

The study explores the required competencies that CPMs require to effectively oversee green retrofitting projects with the aim of reducing carbon tax. These competencies are considered crucial for successfully mitigating the impact of carbon tax and advancing decarbonisation existing infrastructure in the field of green retrofitting (Ametepey et al., 2020). Similar to a study conducted by (Ndlovu and Simbanegavi, 2023), CPMs are having to formalise teams to address built environment concerns, as the frontrunners, they will need to play a proactive role in the decarbonisation of existing infrastructure. The research identifies five core competencies: knowledge of sustainability, skills in environmental assessment, compliance with environmental regulations, resource optimisation, and technical expertise (Participant G, Participant E, Participant M, Participant C, Participant B, Participant D, Participant L, Participant H, Participant J). The findings align with those of a Dutch study, suggesting that, in addition to a strong grounding in sustainability, CPMs should excel in conducting carbon footprint assessments and maintaining regulatory compliance (Silvius et al., 2014). The study also expands existing knowledge by highlighting the significance of waste management and technical skills. These include optimising energy efficiency and collaborating with experts in relevant fields (Participant M, Participant L) (Leite et al., 2013). While financial constraints and limited awareness of sustainable technologies are identified as major barriers in literature, the study offers a

solution-oriented perspective on the existing competencies of CPMs (Participant B, Participant H) (Zahmatkesh et al., 2017). Despite these hurdles, the study posits that CPMs can contribute substantially to carbon reduction efforts, in contradiction with a recent study that posits that sustainability skills are lacking in the built environment sphere (Hassan and Hassan, 2023). This study's identification of core competencies essential for CPMs, including sustainability knowledge, environmental assessment skills, regulatory compliance, resource optimisation, and technical expertise, not only underscores the critical role of CPMs in advancing sustainable retrofitting initiatives but also complements the broader discourse on transdisciplinary approaches to sustainable development, as explored in the Co-Theory Bibliometric Model of Transdisciplinarity (Weaich et al., 2024). This can be achieved through the strategic implementation of sustainable practices such as energy-efficient designs, eco-friendly materials, and the use of renewable energy sources (Participant I). Consequently, the research concludes that enhancing the competencies of CPMs and addressing these barriers can significantly improve the success rate of green retrofitting projects. This, in turn, would contribute to larger-scale efforts to combat climate change (Hassan and Hassan, 2023).

8. CONCLUSION

The study presents a comprehensive examination of the competencies required by Construction Project Managers (CPMs) for the effective implementation of green retrofitting projects aimed at reducing carbon tax. Five critical competencies emerged: Knowledge of Sustainability, Environmental Assessment, Compliance with Environmental Regulations, Resource Optimisation, and Technical Expertise. These skills are in alignment with similar research conducted globally and expand upon existing literature by emphasising the importance of waste management and technical acumen. Notably, the study also identifies significant barriers inhibiting the successful implementation of green retrofitting. Financial constraints and limited awareness of sustainable technologies emerged as chief obstacles. Despite these challenges, CPMs have the potential to significantly contribute to carbon reduction efforts, a finding that contradicts recent research suggesting a lack of sustainability skills in the built environment sector. The study concludes that enhancing the identified competencies and addressing these barriers could significantly improve the success rates of green retrofitting projects. Such improvements would not only align with broader initiatives to combat climate change but also offer a solution-oriented approach to overcoming the existing limitations in the field. The research makes a valuable contribution to the existing body of knowledge by providing a nuanced understanding of the competencies and challenges associated with green retrofitting projects.

9. RECOMMENDATIONS

9.1 Enhancing CPM Competencies for Green Retrofitting

Based on the findings and Cognitive Competency Theory of this study, several recommendations are proposed to enhance the competencies of Construction Project Managers (CPMs) in the realm of green retrofitting, aimed at reducing carbon tax liabilities within the South African construction industry:

9.1.1 Enhanced Educational Programs

Educational institutions and professional bodies should develop and offer specialised courses focused on sustainability, environmental assessment, and compliance with

environmental regulations. These programs should incorporate case studies on successful green retrofitting projects to provide practical insights and knowledge.

9.1.2 Government and Industry Collaboration

There should be increased collaboration between government agencies and the construction industry to facilitate the provision of financial incentives or support mechanisms. These could include tax rebates or grants for projects that demonstrate significant carbon reduction through innovative green retrofitting practices.

9.1.3 Standardisation of Sustainable Practices

Industry bodies, in partnership with regulatory authorities, should work towards the standardisation of sustainable construction practices. This would include the development of clear guidelines and benchmarks for green retrofitting, ensuring consistency and compliance across the sector.

9.1.4 Continuous Professional Development (CPD)

Construction firms and professional associations should prioritise CPD for CPMs, focusing on the latest sustainable technologies, regulatory changes, and best practices in green retrofitting. This could be achieved through workshops, seminars, and online learning platforms.

9.1.5 Promotion of Interdisciplinary Collaboration

Encourage and facilitate greater collaboration between CPMs and experts in energy efficiency, environmental engineering, and sustainability. This interdisciplinary approach can enhance the technical expertise of CPMs and ensure the holistic integration of sustainable practices in retrofitting projects.

9.1.6 Addressing Financial and Knowledge Barriers

Develop targeted strategies to overcome identified barriers, such as financial constraints and limited knowledge of new sustainable technologies. This could involve the creation of awareness campaigns, financial modelling tools to demonstrate long-term savings, and easy access to information on green technologies.

9.1.7 Global Expansion and Technologies in CPM Research

Future research should focus on expanding the geographical scope beyond Johannesburg, Cape Town, and Durban to include other regions within Africa, Asia, Australia, Europe, North America, and South America, potentially uncovering regional variations in competencies and barriers. Additionally, quantitative studies could complement this qualitative research, offering statistical insights into the prevalence of specific competencies among CPMs nationwide. Exploring the impact of emerging technologies, such as artificial intelligence and big data, on green retrofitting projects could provide valuable directions for enhancing CPM competencies. Moreover, longitudinal studies examining the evolution of CPM competencies over time, in response to changing regulatory landscapes and technological advancements, would contribute significantly to the body of knowledge in sustainable construction management.

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