



**TOTAL QUALITY MANAGEMENT PRACTICES ON
GREEN-INNOVATION THROUGH INNOVATIVE
BEHAVIOUR AMONG YEMENI CONSTRUCTION
DEPARTMENT**



DOCTOR OF PHILOSOPHY

2024



Faculty of Technology Management and Technopreneurship

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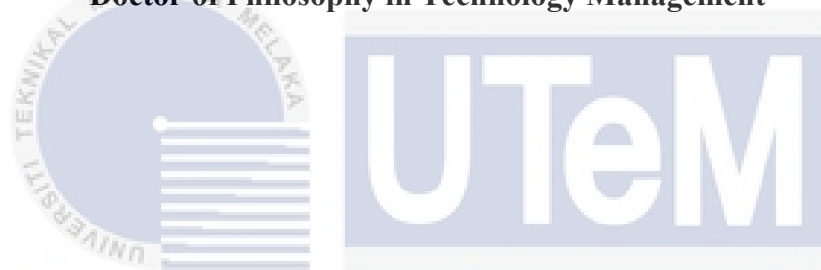
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THROUGH INNOVATIVE BEHAVIOUR AMONG YEMENI CONSTRUCTION
DEPARTMENT**

NABIHAH KAMEL TAWFIQ ABDULMALEK

**A Thesis submitted in fulfilment of the requirements for the Degree of
Doctor of Philosophy in Technology Management**



Faculty of Technology Management and Technopreneurship

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2024

DEDICATION

I dedicate this thesis to my family.



ABSTRACT

The Yemeni construction industry stands as a vital pillar of the country's economy, consistently contributing to its GDP. Despite its economic significance, the department faces challenges, particularly in enhancing its capabilities, notably in the realm of green innovation development. Recent evidence suggests that quality improvement methodologies, such as Total Quality Management (TQM), hold promise in fostering innovation and sustainability. However, the relationship between TQM and green innovation remains debated, especially given the limited empirical exploration of TQM's application within Yemen's construction sector. This study seeks to elucidate the impact of quality management on green innovation, with a focus on the mediating role of innovative work behaviour. To gather data, we used a quantitative research design and distributed questionnaires to 315 managerial-level employees in the Yemen construction department's public sector. Utilising a two-step approach to structural equation modelling, the data underwent rigorous analysis to assess the hypothesised direct and indirect effects. The findings highlight the critical role of TQM practices in catalysing green innovation through innovative work behaviour within the Yemen Construction Department. By integrating environmental considerations into TQM methodologies, construction organisations cultivate a culture of innovation, prompting employees to conceive and implement eco-friendly solutions. Through mechanisms like employee involvement, continuous improvement, and process management, TQM practices facilitate the identification of opportunities for green innovation and encourage proactive engagement in innovative endeavors. This research contributes to the field by offering empirical evidence that elucidates how TQM, as a resource, enhances green innovation through innovative work behavior. It provides a conceptual framework for sustainable innovation, showcasing the potential synergies between TQM practices and green innovation within Yemen's construction sector. Ultimately, this study adds valuable insights to the body of knowledge, highlighting pathways for integrating TQM methodologies and green innovation to drive sustainable development in Yemen's construction department.

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

AMALAN PENGURUSAN KUALITI MENYELURUH TERHADAP INOVASI HIJAU MELALUI TINGKAH LAKU INOVATIF DI KALANGAN JABATAN PEMBINAAN YEMEN

ABSTRAK

Industri pembinaan di Yemen merupakan salah satu tiang utama ekonomi negara tersebut, dengan memberikan sumbangan yang konsisten kepada KDNK. Walaupun begitu, sektor ini menghadapi cabaran, terutamanya dalam meningkatkan keupayaannya, terutamanya dalam bidang pembangunan Inovasi Hijau. Bukti terkini menunjukkan bahawa metodologi peningkatan kualiti, seperti Pengurusan Kualiti Menyeluruh (TQM), menjanjikan dalam memupuk inovasi dan kelestarian. Walau bagaimanapun, hubungan antara TQM dan Inovasi Hijau masih diperdebatkan, terutamanya mengingatkan kajian empirikal yang terhadap mengenai aplikasi TQM dalam sektor pembinaan Yemen. Kajian ini bertujuan untuk menerangkan kesan pengurusan kualiti terhadap Inovasi Hijau, dengan memberi tumpuan kepada peranan pengantara tingkah laku inovatif. Dengan menggunakan reka bentuk penyelidikan kuantitatif, data dikumpul melalui soal selidik yang diedarkan kepada 315 pekerja peringkat pengurusan dalam sektor awam Jabatan Pembinaan Yemen. Dengan menggunakan pendekatan dua langkah kepada pemodelan persamaan struktur, data tersebut dianalisis secara teliti untuk menilai kesan langsung dan tidak langsung yang dihipotesiskan. Hasil kajian menekankan peranan penting amalan TQM dalam menggalakkan Inovasi Hijau melalui tingkah laku inovatif dalam Jabatan Pembinaan Yemen. Dengan menyatukan pertimbangan alam sekitar ke dalam metodologi TQM, organisasi pembinaan membudayakan budaya inovasi, mendorong pekerja untuk mencetuskan dan melaksanakan penyelesaian mesra alam. Melalui mekanisme seperti penglibatan pekerja, penambahbaikan berterusan, dan pengurusan proses, amalan TQM memudahkan pengenalan peluang bagi Inovasi Hijau dan menggalakkan penyertaan proaktif dalam usaha-usaha inovatif. Penyelidikan ini menyumbang kepada bidang ini dengan memberikan bukti empirikal yang menjelaskan bagaimana TQM, sebagai sumber, meningkatkan Inovasi Hijau melalui tingkah laku inovatif. Ia menyediakan kerangka konseptual untuk inovasi lestari, memperlihatkan sinergi yang berpotensi antara amalan TQM dan Inovasi Hijau dalam sektor pembinaan Yemen. Akhirnya, kajian ini menambah pandangan bernilai kepada pengetahuan, menyorot laluan untuk mengintegrasikan metodologi TQM dan Inovasi Hijau untuk memacu pembangunan lestari di Jabatan Pembinaan Yemen.

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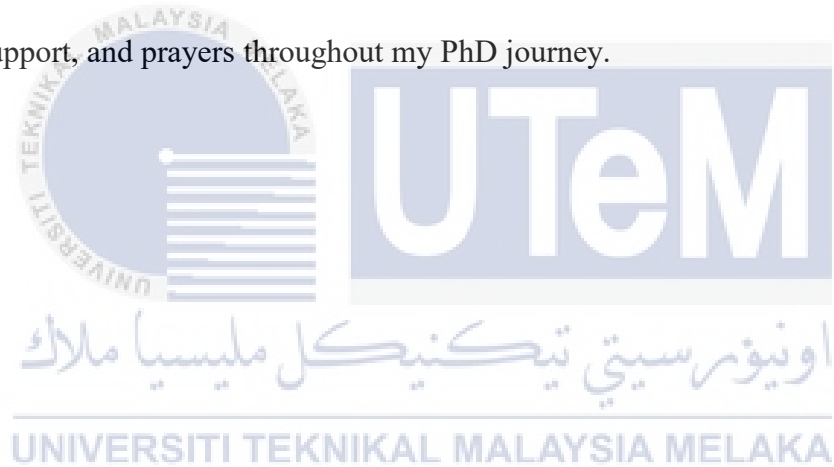


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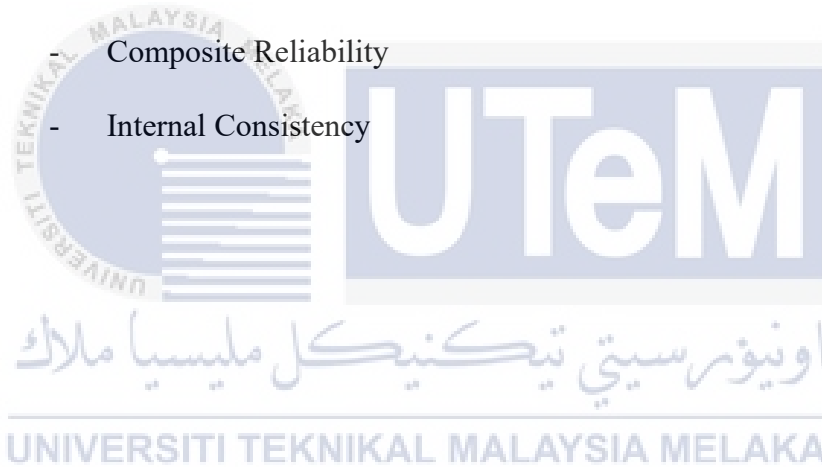
LIST OF SYMBOLS

- R^2 - Coefficient of Determination
 f^2 - Effect Size



LIST OF ABBREVIATIONS

TQM	-	Total Quality Management
IWB	-	Innovative Work Behaviour
PDCA	-	Plan-Do-Check-Act
SEM	-	Structured Equation Model
EFA	-	Exploratory Factor Analysis
CFA	-	Confirmatory Factor Analysis
IV	-	Independent Variables
HR	-	Human Resource
CR	-	Composite Reliability
IC	-	Internal Consistency



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LIST OF PUBLICATIONS

The followings are the list of publications related to the work on this thesis:

1. Nabihah Kameltawfiq Abdulmalek and Amiruddin Ahamat (2022). Analysis of Total Quality Management Practices in the Construction Sector Performance. *Special Education, 1*(43).
2. Nabihah Kameltawfiq Abdulmalek and Amiruddin Ahamat (2022). Total Quality Management and Its Impact on Green Building in the Yemeni Architectural Industry. *Specialusis Ugdymas, 1*(43), 539-552.



INTRODUCTION

Introduction

Yemen's construction industry plays a crucial role in economic and sociological development, but it faces challenges in meeting demand and adopting sustainable practices (Attia 2022). To enhance sustainability and product quality, the industry needs to embrace Quality Management (QM) practices aligned with local customs. However, capability development, particularly in eco-innovation, remains a significant challenge (Zulkefli, Mohd-Rahim, and Zainon 2020).

Lack of awareness, resources, and resistance to change hinder the implementation of green construction in Yemen (Kamel et al., 2022). The construction industry's impact on the environment is significant, with buildings accounting for a substantial portion of CO₂ emissions (International Energy Agency 2019).

Total Quality Management (TQM) has emerged as a recognised strategy for enhancing innovation and addressing industry challenges (Ng and Jee 2012; Ahmed, Inairat, and Alzoubi 2020; Aladwan, AL-Yakoub, and Adaileh 2022). TQM facilitates improved communication, collaboration, and sustainable construction practices (A. Kassem, Khoiry, and Hamzah 2019). However, limited resources, lack of effective communication, and resistance to change pose obstacles to implementing TQM in Yemen's construction industry (Saeed Abdulwasea Hassan, Nordin, and Anuar Azamin 2020; Kamel et al. 2022; Al Asbahi et al. 2020). To achieve sustainable development and fulfil the United Nations' Sustainable Development Goals, eco-innovation, including eco-building, is crucial (Goel

2019; Franco, Pawar, and Wu 2021). However, fragmented research on green innovation capabilities in the construction industry hinders a comprehensive understanding of its long-term viability (Caldera, Desha, and Dawes 2018). Factors such as total quality management and green building influence green innovation in construction (Hazarika and Zhang 2019; Lu et al. 2019; Saieg et al. 2018).

Yemen's construction industry faces additional challenges, including heavy reliance on imports for materials, the need to overcome resistance to change, and limited resources (Zulkefli, Mohd-Rahim, and Zainon 2020; Kamel et al. 2022). The implementation of TQM in green building is relatively new in Yemen, leading to a lack of awareness and understanding of its benefits (Sultan and Alaghbari 2017). Political and economic instability further hinders the industry's ability to invest in TQM practices (Kamel et al., 2022). Resistance to change among industry professionals and the dominance of traditional methods also pose challenges (Al Asbahi et al. 2020).

Additionally, workers and management may resist significant changes to existing processes and procedures that implementing TQM practices may require. The absence of government support further limits resources and capacity, impacting the implementation of TQM practices (Al Asbahi et al. 2020).

In summary, Yemen's construction industry faces challenges in meeting demand and adopting sustainable practices. Embracing QM practices aligned with local customs, overcoming capability challenges, and promoting green innovation are crucial for the industry's long-term viability and contribution to sustainable development. Implementation hurdles include a lack of awareness, limited resources, resistance to change, and dependence on imports. Government support and fostering a supportive

environment are essential for the successful implementation of QM and sustainable practices in Yemen's construction industry.

Statement of the Problem

Environmental sustainability and green innovation are intertwined concepts crucial for addressing the pressing challenges of our time (Halicioglu, 2020). Environmental sustainability refers to the responsible use of resources to meet present needs without compromising the ability of future generations to meet their own needs. It encompasses efforts to conserve natural resources, reduce pollution, and preserve biodiversity. Eco-innovation, on the other hand, involves the development and application of innovative solutions that minimise environmental impact while promoting economic growth and social progress (Munodawafa and Johl, 2019). It represents a proactive approach to environmental challenges, emphasising creativity, ingenuity, and technological advancement to create a more sustainable future. Together, environmental sustainability and green innovation form the cornerstone of efforts to mitigate climate change, preserve ecosystems, and foster a harmonious relationship between humanity and the natural world (Hazarika and Zhang, 2019).

In light of the imperative to address environmental challenges, the late 20th century saw a significant rise in quality awareness, largely driven by the superior quality of Japanese products. Japan's focus on quality control and continuous improvement through methods like Kaizen and Six Sigma led to increased competitiveness and success in global markets. This approach to quality management revolutionised the manufacturing industry and continues to be a crucial factor in driving innovation and customer satisfaction. In recent decades, there has also been a growing awareness of the importance of environmental

quality (Li et al., 2018). The world has seen extreme ecological deterioration, including issues like air and water pollution, deforestation, and climate change. Environmental awareness is now a key issue for governments, businesses, and individuals alike as we seek to mitigate the impacts of human activity on the planet. Efforts to improve environmental quality include measures such as reducing carbon emissions, adopting sustainable practices, and implementing eco-friendly policies (Saeed Abdulwasea Hassan, Nordin, and Anuar Azamin, 2020). These measures not only benefit the environment but also contribute to human well-being by improving the quality of the air we breathe, the water we drink, and the food we eat.

The situation in Yemen regarding energy shortages and environmental pollution is undoubtedly a challenging issue that requires urgent attention and action. The incorporation of both quality management and environmental management into business practices is an important step towards sustainable development in Yemen. Departments, which are the main contributors to various environmental problems, are facing tremendous pressure from the government, consumers, media, environmental non-governmental organisations, and other stakeholders to incorporate both quality management and environmental management into their business practices (Bildirici and Gokmenoglu, 2020). There is a growing body of evidence demonstrating that quality improvement practices, such as Total Quality Management (TQM), can play a significant role in achieving sustainable development.

TQM is an approach to management that seeks to improve quality and performance by focussing on customer satisfaction and continuous improvement (Ahmed, Inairat, and Alzoubi, 2020; Wu et al., 2022). The systematic and integrated implementation of green and overall quality construction, as noted in the literature, has the power to assist green

innovation activities and consequently improve sustainability (Soliman et al., 2022). TQM principles, such as continuous improvement, employee empowerment, and stakeholder engagement, can help businesses identify areas where they can reduce waste and increase efficiency, as well as foster a culture of sustainability within the organisation (Vihari, Yadav, and Panda, 2022).

Yet, conflicting viewpoints on the relationship between Total Quality Management (TQM) and green innovation exist (Li et al., 2018). Some argue that TQM can foster green innovation by providing a structured approach to continuous improvement and customer satisfaction, while others assert that TQM can hinder green innovation by placing too much emphasis on existing processes and systems (Abbas, 2020). One argument in favour of TQM promoting green innovation is that it can help businesses identify areas where they can reduce waste and increase efficiency. This can lead to the development of new processes and technologies that are more environmentally friendly (Azam et al., 2022). TQM principles such as continuous improvement, stakeholder engagement, and employee empowerment can also foster a culture of innovation and experimentation, which can be key to developing new green products and services.

On the other hand, some argue that TQM can hinder green innovation by placing too much emphasis on existing processes and systems. TQM can be a very structured and rigid approach to management, which can make it difficult for businesses to deviate from established processes and systems (Li et al., 2018). This can make it challenging for businesses to embrace new technologies or processes that may be more environmentally friendly but require significant changes to the existing systems and processes. Meeting customer needs and expectations is often the focus of TQM and green innovation, posing another potential challenge (Li et al., 2018). This can make it difficult for businesses to

prioritise sustainability over customer demands for low cost and convenience. This can result in a focus on incremental improvements rather than more radical innovations to address environmental challenges.

Li et al. (2018) have not extensively explored the relationship between Total Quality Management (TQM) and eco-innovation, particularly in the context of sustainability. TQM's application in Yemen's construction sector and its impact on green innovation are particularly underexplored. The Yemeni construction sector faces many challenges, including low productivity, subpar quality, poor safety, and schedule and cost overruns, all of which lower the value of the finished projects (Kamel et al., 2022) (Said, Nasser, and Alkhulaidi, 2021). This research aims to fill these gaps by investigating the relationship between TQM and green innovation in Yemen's construction sector. It aims to understand how TQM practices influence green innovation, as well as whether innovative behavior mediates this relationship. By addressing these objectives, the research aims to contribute to the understanding of how quality management practices can support environmentally sustainable practices and facilitate innovative behaviour within organisations. The findings will have implications for organisations, policymakers, and researchers in their pursuit of sustainable development and promotion of eco-friendly practices in various industries.

Research Objectives

Given the preceding debate, the current thesis has the following goal:

RO1: To investigate the effectiveness of Total Quality Management (TQM) on green innovation practices in the Yemen construction department.

RO2: To examine the relationship between Total Quality Management (TQM) and innovative work behaviour in the Yemen construction department.

RO3: To measure the mediate effect of innovative work behaviour on the relationship between Total Quality Management (TQM) and green innovation practices in the Yemen construction department.

RO4: To validate a model of green innovation through the interaction between Total Quality Management (TQM) and innovative work behaviour in the Yemen construction department.

Research Questions (RQ)

In light of the preceding debate, the current research aims to address the following questions:

RQ1: To what extent does Total Quality Management (TQM) influence green innovation practices in the Yemen construction department?

RQ2: Does Total Quality Management (TQM) influence innovative work behaviour in the Yemen construction department?

RQ3: Does innovative work behaviour mediate the relationship between Total Quality Management (TQM) and green innovation practices in the Yemen construction department?

RQ4: What is the appropriate model of the factors that affect green innovation in the Yemen construction department?