AI TECHNOLOGY FACTORS MEDIATED VIA INTENTION TO USE IN UAE PETROLEUM COMPANIES CASE STUDY

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UNIVERSITI TEKNIKAL MALAYSIA MELAKA

MASTER OF SCIENCE IN TECHNOLOGY MANAGEMENT

2024

Faculty of Technology Management and Technopreneurship

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A thesis submitted
in fulfillment of the requirements for the degree of
Master of Science in Technology Management

Faculty of Technology Management and Technopreneurship

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2024

DEDICATION

This work is dedicated to the inspiring people in my life, my dear father and my dear mother, who have always wanted the best for me. Their boundless love and the countless prayers they've offered on my behalf have been the pillars of my strength and motivation throughout this journey.

…To my great guide…

My dear supervisor, Ts. Dr. Yusri bin Arshad. Your unwavering belief in my abilities and your dedicated guidance have been instrumental in shaping this endeavor. Your mentorship has illuminated my path and enriched my understanding. I am deeply grateful for your support, patience, and wisdom, which have been the driving force behind the completion of this work. Your mentorship has not only enriched my academic journey but also left an indelible mark on my personal and professional growth. Thank you for being a source of inspiration and for helping me navigate the challenges along the way.

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ABSTRACT

Artificial Intelligence (AI) represents a transformative force globally, with its computational prowess, data accessibility, and revolutionary algorithms. While the United Arab Emirates (UAE) has set a national AI strategy 2031 as a testament to AI's transcendent potential, the actual adoption of AI within the UAE, like in many governments, remains at a nascent stage, necessitating a comprehensive exploration of the underlying complexities and obstacles. This research undertakes a thorough investigation into the determinants shaping the adoption of AI technologies within the United Arab Emirates' oil and gas sector. By integrating the Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT), this study constructs a robust theoretical framework for scrutinizing AI technology adoption in a distinct industry context. Specifically, this research focuses on discerning the pivotal factors influencing AI adoption within the Abu Dhabi National Oil Company (ADNOC). These factors encompass perceived ease of use, perceived usefulness, technology attitude towards AI, perceived knowledge in AI, and behavioral intention to use AI. The research encompasses a sample of 500 practitioners and employees operating within ADNOC's information systems and technology department. For quantitative analysis, data collected from the respondents are analyzed using widely recognized statistical tools, namely the Statistical Package for the Social Sciences (SPSS) version 29 and Smart-Pls 3.3.9. A total of 329 valid questionnaires serve as the basis for statistical data analysis. The results reveal that behavioral intention to use AI partially mediates the relationship between each respective independent variable (perceived ease of use, perceived usefulness, technology attitude towards AI, and perceived knowledge in AI) and AI adoption within ADNOC. This mediation signifies that behavioral intention plays a discernible role in influencing the impact of these independent variables on AI adoption, although the relationships are not entirely mediated by behavioral intention. Furthermore, this research enriches the domain of technology adoption models by presenting a holistic framework that integrates TAM and UTAUT. This integration furnishes a more comprehensive understanding of user behavior and acceptance of AI technologies in the UAE oil and gas sector. Moreover, the study validates the conceptual model for this specific industry, ensuring its alignment with the sector's unique needs and challenges, thereby providing a relevant framework for AI technology adoption. Practically, this research offers valuable insights to organizations operating in the UAE oil and gas sector. By identifying key factors such as perceived ease of use, perceived usefulness, technology attitude towards AI, and perceived knowledge in AI, the study assists industry stakeholders in making well-informed decisions regarding the adoption and implementation of AI technologies. Furthermore, the research lays the groundwork for future investigations in cooperative banking performance analysis, both within the UAE and globally, thus contributing to advancements in the field of strategic quality planning. Based on the findings, it is recommended that organizations in the UAE oil and gas sector prioritize enhancing the perceived ease of use and usefulness of AI technologies to stimulate their adoption. Additionally, industry stakeholders should invest in employee training and knowledge-building programs to cultivate a more positive attitude towards AI. Future research should broaden its scope to encompass comparative studies

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across industries and explore the enduring impact of AI adoption on business performance. In conclusion, this research provides a comprehensive comprehension of AI technology adoption in the UAE oil and gas sector, bridging theoretical, practical, and methodological aspects. It offers a valuable roadmap for organizations and researchers, propelling further progress in the dynamic field of technology adoption.

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FAKTOR TEKNOLOGI AI DIMEDIASI MELALUI NIAT UNTUK MENGGUNA DALAM KAJIAN KES SYARIKAT PETROLEUM UAE

ABSTRAK

Kecerdasan Buatan (AI) mewakili satu daya ubah yang mendasar di peringkat global, dengan keupayaan komputasinya, aksesibiliti data, dan algoritma revolusioner. Walaupun Emiriah Arab Bersatu (UAE) telah menetapkan strategi kebangsaan AI 2031 sebagai bukti potensi transenden AI, penggunaan sebenar AI di dalam UAE, seperti dalam banyak kerajaan, masih pada peringkat permulaan, memerlukan penyelidikan menyeluruh ke atas kompleksiti dan halangan yang melibatkan. Kajian ini menjalankan penyiasatan menyeluruh ke atas faktor-faktor yang membentuk penggunaan teknologi AI di dalam sektor minyak dan gas Emiriah Arab Bersatu. Dengan menggabungkan Model Penerimaan Teknologi (TAM) dan Teori Penerimaan dan Penggunaan Teknologi yang Tersatukan (UTAUT), kajian ini membina satu kerangka teori yang kukuh untuk mengkaji penggunaan teknologi AI dalam konteks industri yang berbeza. Secara khusus, kajian ini memberi tumpuan kepada mengenal pasti faktor-faktor penting yang mempengaruhi penggunaan AI dalam Syarikat Minyak Nasional Abu Dhabi (ADNOC). Faktor-faktor ini merangkumi persepsi kemudahan penggunaan, persepsi kegunaan, sikap teknologi terhadap AI, pengetahuan yang dirasai tentang AI, dan niat tingkah laku untuk menggunakan AI. Kajian ini merangkumi sampel 500 orang yang berpraktik dan bekerja dalam jabatan sistem maklumat dan teknologi ADNOC. Untuk analisis kuantitatif, data yang dikumpulkan daripada responden dianalisis menggunakan alat statistik yang diiktiraf secara meluas, iaitu Pakej Statistik untuk Sains Sosial (SPSS) versi 29 dan Smart-Pls 3.3.9. Sebanyak 329 borang soal selidik yang sah menjadi asas untuk analisis data statistik. Hasil kajian menunjukkan bahawa niat tingkah laku untuk menggunakan AI sebahagian menengahkan hubungan antara setiap pembolehubah bebas yang berkenaan (persepsi kemudahan penggunaan, persepsi kegunaan, sikap teknologi terhadap AI, dan pengetahuan yang dirasai tentang AI) dan penggunaan AI dalam ADNOC. Mediasi ini menandakan bahawa niat tingkah laku memainkan peranan yang dapat dikenal pasti dalam mempengaruhi kesan pembolehubah-pembolehubah bebas ini terhadap penggunaan AI, walaupun hubungan-hubungan tersebut tidak sepenuhnya dimediasi oleh niat tingkah laku. Selanjutnya, kajian ini memperkaya domain model penerimaan teknologi dengan menyajikan satu kerangka yang holistik yang menggabungkan TAM dan UTAUT. Penggabungan ini memberikan pemahaman yang lebih komprehensif mengenai tingkah laku pengguna dan penerimaan teknologi AI di dalam sektor minyak dan gas UAE. Selain itu, kajian ini mengesahkan model konseptual untuk industri khusus ini, memastikan kesesuaiannya dengan keperluan dan cabaran unik sektor tersebut, dengan itu menyediakan kerangka yang relevan untuk penggunaan teknologi AI. Dalam praktiknya, kajian ini memberikan wawasan yang berharga kepada organisasi yang beroperasi di sektor minyak dan gas UAE. Dengan mengenal pasti faktor-faktor utama seperti persepsi kemudahan penggunaan, persepsi kegunaan, sikap teknologi terhadap AI, dan pengetahuan yang dirasai tentang AI, kajian ini membantu pihak berkepentingan industri membuat keputusan yang berinformasi dengan baik mengenai penggunaan dan pelaksanaan teknologi AI. Selain itu, penyelidikan ini

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membentuk asas untuk penyelidikan masa depan dalam analisis prestasi perbankan kerjasama, baik di dalam UAE mahupun secara global, dengan itu menyumbang kepada kemajuan dalam bidang perancangan kualiti strategik. Berdasarkan temuan ini, disyorkan agar organisasi di sektor minyak dan gas UAE memberi keutamaan kepada meningkatkan persepsi kemudahan penggunaan dan kegunaan teknologi AI untuk merangsang penggunaannya. Selain itu, pihak berkepentingan industri seharusnya melabur dalam program latihan pekerja dan program pembinaan pengetahuan untuk membina sikap yang lebih positif terhadap AI. Penyelidikan masa depan sepatutnya meluaskan skopnya untuk melibatkan kajian perbandingan merentasi industri dan meneroka kesan berkekalan penggunaan AI terhadap prestasi perniagaan. Kesimpulannya, kajian ini memberikan pemahaman komprehensif mengenai penggunaan teknologi AI di sektor minyak dan gas UAE, merangkumi aspek teori, praktikal, dan metodologi. Ia menawarkan peta jalan yang berharga kepada organisasi dan penyelidik, memacu kemajuan lebih lanjut dalam bidang penggunaan teknologi yang dinamik.

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ACKNOWLEDGEMENT

I begin by expressing my profound gratitude to the Almighty, Allah (SWT), for His blessings and guidance, which have culminated in the successful completion of my thesis. The journey of this master's research has been replete with challenges and complexities, but it has ultimately led to a gratifying conclusion. I am deeply thankful to Allah (SWT) and for the prayers extended by my family and friends, whose unwavering support has been instrumental in this achievement.

My sincere appreciation is extended to my esteemed supervisor, Ts. Dr. Yusri bin Arshad, whose pivotal role in this endeavor warrants special mention. Ts. Dr. Yusri bin Arshad generosity in providing constructive feedback and guidance has significantly contributed to the refinement of my work. His consistent patience and willingness to address any issues encountered during the course of this research are deeply appreciated.

I also wish to express my heartfelt gratitude to my thesis examiners, whose valuable insights and feedback have enriched the quality of this research. Your expertise and discerning evaluation have been instrumental in shaping this work.

Furthermore, I would like to acknowledge the University Technical Malaysia (UTeM) for providing an enriching academic environment conducive to research. I am grateful for the support and camaraderie extended by my fellow students. I reserve a special note of thanks to my family, particularly my mother, along with my sisters, brothers, and friends. Their enduring encouragement and unwavering support have been a wellspring of strength and motivation throughout my research journey, even when it entailed studying abroad. Your steadfast belief in me has been a cornerstone of this achievement.

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LIST OF ABBREVIATIONS

AIA	-	AI Adoption
AVE	-	Average variance extracted
BI	-	Behavioral Intention to Use AI
CR	-	Composite reliability
CFA	-	Confirmatory factor analysis
EC	-	Environment characteristics
EFA	-	Exploratory factor analysis
GoF	-	Goodness of fit
GCC	-	Gulf cooperation council
H	-	Hypothesis
4IR	-	National Fourth Industrial Revolution
PEoU	-	Perceived Ease of Use
PK	-	Perceived Knowledge in AI
PU	-	Perceived Usefulness
ATT	-	Technology Attitude Towards AI

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LIST OF SYMBOLS

f^2	-	Effect Size
$\mathcal{R}^2$	-	Coefficients of Determination
Q^2	-	Predictive Relevance

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LIST OF PUBLICATIONS

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

Al Balushi, S. M., and Arshad, Y. B., 2023. Trends and Patterns in Artificial Intelligence Research for Oil and Gas Industry: A Bibliometric Review. International Journal of Professional Business Review: Int. J. Prof. Bus. Rev., 8(6), 19.

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CHAPTER 1

INTRODUCTION

1.1 Introduction

This chapter serves as the central component of the thesis, encapsulating the fundamental aspects of the research. In the early section of this chapter, the current research specifies research backgrounds and explores research problems and gaps from the literature. Furthermore, the present study elaborates on the research questions, objectives, scope, significance, definitions of terms, and structure of the thesis. Lastly, the study provides the overall summary of the chapter.

1.2 Background of the Study

Artificial Intelligence (AI) stands as the defining technological innovation of the upcoming decade, poised to significantly enhance human capabilities while maintaining cost-efficiency (George, 2023). It is predicted that AI will permeate most industries, with an estimated contribution of US $15.7 trillion to the global economy by 2030 (Merhi, 2023). The multifaceted utility of AI extends across numerous domains, including healthcare (enabling early disease detection) (Zhuhadar and Lytras, 2023), customer service (offering personalized assistance) (Allioui and Mourdi, 2023), education (facilitating individualized teaching aids) (Eslit, 2023), transportation (through automated vehicles) (Nishant et al., 2020), and notably, the oil and gas sector, where AI adoption is transforming upstream and midstream operations (Gupta and Shah, 2022). The profound impact of AI across these domains underscores its transformative potential in enhancing human endeavors.

Consequently, understanding the factors that contribute to user acceptance of AI is imperative to foster its widespread adoption (Schmidt, 2023; Gupta and Shah, 2022; Sohn and Kwon, 2020; Dora et al., 2022).

Furthermore, the oil and gas industry (OGI) has historically played a pivotal role in the global economy, characterized by its intricate and rapidly evolving landscape. In recent years, the advent of AI has brought new opportunities and challenges to the industry, promising to revolutionize the way oil and gas companies operate (Shahzad et al., 2023). AI, as a computational discipline, seeks to emulate human cognition for decision-making and problem-solving by amalgamating computer science with robust datasets. Researchers have harnessed a myriad of AI algorithms to construct specialized prediction systems based on input data (Shrivastava, 2023). These AI technologies promise to unlock substantial value by enabling advanced data analytics, predictive maintenance, process automation, and more informed decision-making, ultimately optimizing production rates and reducing operational costs (Gupta and Shah, 2022). AI's applications extend to improving reservoir modeling, averting maintenance needs, and defect detection, thereby enhancing maintenance efficiency and reducing failures (Sircar et al., 2021).

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The integration of AI within the OGI has witnessed rapid expansion, manifesting in intelligent drilling, production, and refining processes, significantly impacting exploration and development (Li et al., 2021). Notably, AI has contributed to mitigating exploration risks and increasing the success rate of exploration wells through the development of precise techniques for fracture scheme design and well selection (Li et al., 2021). Although AI has been widely adopted for reservoir enhancement, the era of big data necessitates a comprehensive exploration of the untapped potential inherent in large datasets for oilfield operations enhancement, including the identification of concealed, previously unknown, and

potentially valuable information (Choubey and Karmakar, 2021). The burgeoning significance of AI in oilfield development is intrinsically linked to advancements in big data technologies, coupled with the continuous refinement of various AI algorithms. Furthermore, the integration of AI with complementary technological advancements, such as cloud computing, the Internet of Things, and virtual reality, is poised to yield novel AI-based systems and innovations that can substantially reduce costs and enhance operational efficiency (Koroteev and Tekic, 2021).

Despite the increasing advocacy for the widespread adoption of AI in the OGI, a consensus on its effectiveness within the field remains elusive (Gupta and Shah, 2022). In response to the rapid technological progression of AI, a surge in studies has emerged, investigating the antecedents of AI acceptance and extending acceptance frameworks. However, a notable gap persists in the current literature concerning the synthesis of factors influencing user acceptance of AI. User acceptance, defined as the behavioral intention or willingness to use, purchase, or explore a product or service, assumes paramount importance, given AI's potential societal benefits in diverse sectors, including transportation (Nishant et al., 2020), healthcare (Zhuhadar and Lytras, 2023), and education (Eslit, 2023). Hence, comprehending the factors that facilitate the acceptance and adoption of AI technology remains an imperative and central objective of this study.

In light of the preceding context, the primary objective of this research is to establish a framework for the successful adoption of AI within the oil and gas industry, aiming to elucidate the key factors that underpin its acceptance and integration while harnessing its transformative potential in this vital sector.

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1.2.1 Artificial Intelligence in the UAE Oil and Gas Sector

In an era marked by a global surge in digital transformation across business and non-business sectors, the oil and gas industry stands as no exception. The adoption of innovative technologies has been a resounding response by the oil and gas sector worldwide to the evolving technological landscape (Gupta and Shah, 2022). The United Arab Emirates (UAE) has exemplified this commitment to technological advancement within its oil and gas sector. Pioneering the adoption of cutting-edge innovations such as advanced robotics, autonomous underwater vehicles, 3-D scanning technology, and Artificial Intelligence (AI), the UAE's oil and gas industry has witnessed substantial enhancements in production, exploration, safety, and overall system monitoring (Al Balushi and Arshad, 2023).

At the forefront of this technological revolution in Abu Dhabi is the Abu Dhabi National Oil Company (ADNOC), a global industry leader renowned for its remarkable daily production capacity of nearly 4 million barrels of oil, 11 billion cubic feet of raw gas, and over 1 billion cubic feet of sour gas (Hosani and Ghouri, 2022). ADNOC has strategically positioned itself as one of the world's largest oil and gas producers, fueled by an unwavering commitment to adopting and implementing the latest innovative technologies and approaches. This strategic vision aims to optimize operations, elevate production output, and position ADNOC as a global benchmark for both cost-effectiveness and environmental sustainability (ADNOC, 2019).

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The need to support innovation and technology adoption in the oil sector stems from the sector's significance to the UAE and the government's innovation agenda. The government's agenda for innovation in all of the country’s economic and social sectors, along with the need to remain technologically competitive with international oil producers and

reap the benefits of technology in oil and gas production, underscores the importance of adopting innovative technologies in the UAE's oil and gas sector (Hosani and Ghouri, 2022).

The UAE's oil and gas industry has created a supportive climate for innovation aimed at achieving production excellence and efficiency (Al Balushi and Arshad, 2023), bolstered by ongoing clean energy awareness campaigns (Khan et al., 2021). The inherent risks associated with oil and gas production and environmental concerns (Hashmi et al., 2020) have necessitated intensive technological use to reduce human involvement and enhance operational efficiency.

The trajectory of reduced human involvement and enhanced operational efficiency is closely linked to the adoption of innovative technologies in oil and gas production processes in the UAE (Waqar et al., 2023). The integration of diverse innovations such as robotics, autonomous underwater vehicles, 3-D scanning technology, Internet of Things (IoT), and advanced robotics across various segments of the oil and gas sector has translated into real operational efficiency (Jagatheesaperumal et al., 2021). These technological advancements extend beyond production enhancement to ensure the safety of all personnel engaged in oil and gas exploration, drilling, extraction, processing, and production activities (Waqar et al., 2023). These strides have introduced novel approaches to exploration, extraction, drilling, processing, and production while simultaneously revolutionizing monitoring and inspection practices during the production of oil and gas products. These innovations have empowered oil and gas companies to venture into increasingly challenging environments with heightened confidence (Hosani and Ghouri, 2022). For instance, the development of fiber optic sensing systems has significantly improved the safety of offshore drilling platforms. In summary, the oil and gas industry has realized substantial benefits from the adoption and utilization of technological innovations, driving operational quality, productivity gains, and

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