

Midocean University
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**The role of project design management in raising the efficiency of
the implementation of engineering projects in the oil and gas sector: an
applied study in Saudi Arabia**

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Dedication

- For my parents,

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Abstract.

The focus of this study is to analyze use-case of Project Design Management PDM and its effect on the operational effectiveness on engineering projects implemented in the oil and gas industry in Saudi Arabia. Specifically, the study seeks to assess the effect of enhancements in the PDM dimensions of Project Planning, Risk Management, Cost Management, and Resource Management on the Implementing Efficiency of the Project in light of Saudi Vision 2030.

The research followed a descriptive–analytical and quantitative approach, where data was collected through a questionnaire built on the five-point Likert Scale provided to 400 respondents working in the Saudi oil and gas industry. Using the SPSS tool, the data was subjected to an array of statistical tests, including reliability tests, correlation, and multiple regression analyses.

The study findings show that all four Project Design Management components analyzed positively and significantly affect effectiveness of implementation. Planning and Cost Management exerted the greatest influence, followed abdominal Risk and Resource Management as moderate contributors. The data suggests that the more risk is passed through structured planning, cost controlled, and risk minimized, the more reliable the project is in meeting the objectives of 'time, cost and quality control."

This investigation marks further progress for scholarship by enriching literature with contextual empirical data pertaining to the Saudi industrial sector and extends contemporaneous insight and actionable steps on PDM principles within the strategic management of oil and gas projects. It also serves the purpose of enhancing operational excellence, sustainability, and efficiency in the oil and gas industry in line with the industrial pivots endorsed in Vision 2030.

Keywords: Project Design Management, PDM, Efficiency, Planning, Project Risk Management, Cost Control, Resource Management, Oil Industry, Gas Industry, Saudi Arabia, Vision 2030.

CHAPTER ONE: INTRODUCTION

1.1. Background

The role of project design management is one of the main pillars in the modern business world, as it represents a scientific and methodological framework aimed at planning, implementing, monitoring and successful termination of any institutional project, whether in the engineering, service, technology, or other sectors. The role of project design management is not just organizing a set of tasks or tracking schedules, but rather an integrated system that aims to transform ideas into tangible achievements, by directing human, financial and technical resources in a coordinated and planned manner to achieve specific goals within a certain time frame and budget. This management approach is based on a set of standards, tools and practices aimed at ensuring efficiency and effectiveness in performance, reducing risks, and achieving quality outputs.

The main function of the role of the project design department is to clearly define the strategic objectives of the project, and then divide them into structured implementation stages starting with the "start-up" phase, where the idea is analyzed and its feasibility, passing through the "planning" stage, in which a detailed structure is prepared that includes defining the scope of work, estimating costs, allocating resources, setting schedules, and assessing risks. This is followed by the "implementation" phase, where plans are translated into practice, including coordination between teams, ensuring efficient workflow, and dealing with emergency obstacles. The fourth phase is "monitoring and control", in which project performance is measured, deviations from the basic plan are analyzed, and necessary corrective actions are taken. Project management concludes with a "lockdown" phase, which includes a comprehensive assessment of work, delivery of results, and documentation of lessons learned.

The role of the Project Design Department is important in that it contributes to achieving optimal use of resources, reducing waste, raising the quality of implementation, and ensuring a balance between time, cost and quality. It is also a vital tool in supporting decision-making, adapting to environmental variables, and competing in global markets that require high flexibility and rapid response. With rapid technical and economic developments, the role of project design management is increasingly relying on technology, such as specialized software to manage schedules, cost analysis, and communication between teams, making the process more efficient, transparent and accurate.

In addition, the role of project design management is closely linked to the organization's culture and leadership style, as it requires positive interaction between different teams, providing an environment that supports creativity and innovation, as well as the importance of motivation and effective communication to ensure commitment to goals. In this context, the importance of leadership and soft skills (soft skills) of the project manager is highlighted, such as the ability to solve problems, negotiate, work under pressure, and build positive relationships with stakeholders, because the project is not only managed with tools and techniques, but also with strong human relationships.

In light of the above, the role of project design management is no longer a traditional administrative function but has become a scientific discipline in its own right, taught in major universities, and enjoys international accreditation such as the PMP certificate from the Institute of Project Design Management Houses (PMI). Today, it is an indispensable tool for organizations aspiring to achieve operational efficiency, competitive leadership and sustainable growth.

Raising the efficiency of the implementation of engineering projects is one of the main pillars in urban planning policies and sustainable urban development, because of its direct impact on the quality of life of the population and enhancing social and economic

stability within cities. The development of neighborhoods does not only mean the construction of new buildings or the improvement of infrastructure, but also includes a human, social, economic and cultural dimension. Data protection is the immediate environment in which individuals and families live, a space where their sense of belonging and identity is shaped and influenced by the level of services, the environment, employment opportunities, and social interaction.

The concept of raising the efficiency of the implementation of engineering projects stems from the awareness of the gap between neighborhoods within cities, whether in terms of infrastructure, services, population density or quality of buildings, which sometimes leads to the emergence of neglected or random areas that lack the minimum urban components. Therefore, development strategies seek to rehabilitate these areas by improving roads, water, electricity and sewage networks, providing parks and public facilities, and establishing educational, health and cultural centers, which contribute to raising the standard of living and reducing urban and social marginalization.

Moreover, increasing the efficiency of engineering project implementation requires a participatory approach that includes all stakeholders, from government agencies and real estate developers to the population itself, who must have a pivotal role in setting development priorities and providing feedback on their real needs. Many countries today adopt modern concepts in this area such as "community-oriented development", "smart neighborhood planning" and "progressive improvement", all of which aim to balance urban growth with the preservation of the local and cultural character of neighborhoods, without compromising the spirit of place or expelling indigenous people.

The economic aspect cannot be overlooked in raising the efficiency of the implementation of engineering projects, as these projects contribute to activating the real estate movement, creating direct and indirect job opportunities in the fields of construction,

maintenance and services, and leading to an increase in the market value of real estate. Supporting affordable housing is one of the most prominent components of the development process, to ensure that these projects do not turn into elite areas that exclude low-income people, which causes an imbalance in the social balance and exacerbates class disparity within cities.

In light of the escalating environmental challenges, it has become necessary to raise the efficiency of the implementation of engineering projects taking into account the principles of environmental sustainability, through the use of environmentally friendly building materials, enhancing energy efficiency, and relying on urban designs that take into account natural ventilation and reduce carbon emissions, while increasing green spaces and reducing random horizontal expansion. Some global cities adopt the concepts of "zero carbon neighborhoods", "pedestrian-friendly cities" and "urban humanization" in the development of their neighborhoods, as advanced examples of the integration between the environment and urban development.

In general, raising the efficiency of the implementation of engineering projects represents a complex process that requires coordination between various sectors, long-term planning that takes into account current and expected needs, and depends on a comprehensive vision of the city as a living organism that evolves with time, where urbanization overlaps with man, the economy with the environment, and the past with the present and the future.

The role of the Project Design Department is a pivotal tool in the success of efforts to raise the efficiency of the implementation of engineering projects adjacent to the Riyadh Metro, especially in light of the ambitious vision of the Kingdom of Saudi Arabia towards achieving sustainable and balanced urban development. With the rapid urbanization and growing population density in the capital, the importance of developing these neighborhoods has emerged as a vital area that contributes to improving the quality of life, raising the

efficiency of land use, and supporting public transportation, especially the Riyadh metro project, which is one of the largest infrastructure projects in the region.

The role of the Project Design Department in this context is to develop an integrated plan to qualify the protection of data surrounding metro stations, so that development processes are directed in a thoughtful and effective manner that ensures compatibility with the infrastructure of the project, and achieves integration between transportation, residential and service areas. This includes developing urban plans, improving road networks and pedestrian walkways, and providing a safe and stimulating urban environment for the use of public transport, reducing dependence on private vehicles and contributing to reducing congestion and pollution.

Within the role of the Project Design Department, the process of developing neighborhoods adjacent to the Riyadh Metro requires professional methodologies that include precise stages that begin with determining the scope of the project, analyzing population needs, assessing the current situation in terms of infrastructure, urban density, and level of services, and then moving to the planning stage, which includes preparing schedules, allocating resources, and drawing a roadmap for implementation. All this must be done in coordination with the concerned authorities such as the Riyadh Development Authority, the City Municipality, and the Riyadh Train Company, to ensure institutional integration.

The management of these projects also requires high flexibility in dealing with project variables, due to the multiplicity of stakeholders, the different priorities of the population, and the different nature of the neighborhoods surrounding each metro station. For example, some areas may be densely populated and need comprehensive rehabilitation, while others require simple interventions such as improving sidewalks or aesthetically urbanizing. Risk management, feasibility analysis, and cost estimation tools are important to ensure that goals are achieved without exceeding budgets or timelines.

On the other hand, the role of the Project Design Department in this field seeks to create an integrated urban model known as "mixed use development", where residential, commercial, recreational, educational and service functions are integrated into a single environment, enhancing urban life and encouraging residents to use the metro as the main means of transportation. This type of development not only increases the value of the property in the areas adjacent to the stations, but also enhances the economic attractiveness of these neighborhoods, turning them into vibrant urban activity centers.

The role of the Project Design Department also relies on modern technologies in tracking and implementation, such as geographic information systems (GIS), agile project management methodologies, and urban modeling techniques, which facilitates timely decision-making and ensures accurate performance tracking. Community engagement is also an integral part of the project management phase, as it contributes to enhancing community satisfaction and providing an environment responsive to the aspirations and actual needs of the residents.

The development of neighborhoods adjacent to the Riyadh Metro is not only an urban project, but a development project at its core, in which issues of urban planning, public policies, real estate investment, and urban behavior overlap. Hence, the management of this type of project represents a strategic challenge that requires careful coordination between all these factors, while emphasizing the importance of an integrated vision that combines the environmental, social, economic and urban dimension, to achieve the ultimate goal of building a smart, balanced, and sustainable city, worthy of the Kingdom's Vision 2030.

Based on this, the problem of the study is to analyze the impact of the role of project design management in its combined dimensions, represented in (project planning - project risk management - project cost management - project resource management) in raising the

efficiency of the implementation of engineering projects by applying to the oil and gas sector in Saudi Arabia.

1.2. Search problem

In recent years, the Kingdom of Saudi Arabia has been witnessing major strategic transformations within the framework of its ambitious Vision 2030, as it seeks to diversify the national economy and enhance operational efficiency in vital sectors, especially the energy sector. This sector is one of the most complex and sensitive, due to its size and direct impact on the national economy, and its increasing reliance on technology and smart systems. With this transformation, automation and digital solutions have become an urgent necessity to ensure the sustainability of operations, achieve efficiency and transparency, and reduce human error and waste of resources.

However, the implementation of automation projects in the energy sector still faces significant challenges related to system integration, resistance to institutional change, poor coordination between stakeholders, and the absence of a unified digital vision in some projects. In this context, project design management stands out as a critical factor that can contribute to overcoming these challenges. Project design management goes beyond traditional concepts of project management to adopt digital technologies such as smart planning tools, predictive analytics, artificial intelligence, and data cloud technologies, which enhances the accuracy of implementation, supports data-driven decisions, and increases the efficiency of communication and integration between different teams.

The research problem addressed by this research stems from a noticeable gap between the possibilities offered by project design management and the practical reality of applying automation solutions in energy projects. Despite the availability of technological infrastructure and the availability of technical competencies to some extent, a large proportion of automation projects face difficulties in implementing on the ground, whether

in terms of adhering to timelines, in terms of integration between different systems, or even in measuring the return on digital investment. These challenges point to the need to examine the relationship between project design management practices and the successful implementation of automation solutions in the sector.

Accordingly, the research seeks to answer the main question: What role does Project Design Department play in facilitating and improving the implementation of automation solutions in the oil and gas sector in Saudi Arabia?, and how effective are digital tools and methodologies in addressing traditional challenges facing the application of automation? The research also explores the readiness of the energy sector to adopt these methodologies, and the institutional ability to adapt to the requirements of digital transformation in project management.

This research problem is of great applied importance, given that the success of automation projects in energy does not depend only on the availability of technology, but also requires effective digital management that enables the transformation of digital vision into practical reality, which contributes to improving performance, reducing costs, raising the level of safety and efficient operation, which the study seeks to analyze through an applied field perspective.

1.3. Importance of the study:

The importance of this study depends on its theoretical and practical contributions to the following:

1.3.1. Theoretical significance:

Enriching the scientific literature in the field of the role of urban project design management by studying the relationship between the mechanisms of the role of project design management and the effectiveness of raising the efficiency of the implementation of

engineering projects adjacent to the Riyadh Metro, especially in light of the major urban transformations in the capital.

Provide a modern theoretical framework that links the components of urban development projects (such as transport integration, use intensity, infrastructure improvement, and quality of urban life) with the outputs of the project design management role such as adhering to schedules, reducing deviations, and improving the quality of implementation.

Bridging a knowledge gap in Arab urban and administrative studies, which did not adequately address the relationship between major transport projects (such as the metro) and their impact on raising the efficiency of the implementation of engineering projects from an administrative and planning perspective.

Contribute to the development of quantitative and qualitative assessment tools to be used in the future to measure the success of the strategies of the role of project design management in guiding integrated urban development and achieving the goals of sustainable urban transformation in the capital.

1.3.2. Applied importance:

Supporting decision-makers in the authorities concerned with urban development and urban planning with accurate indicators on the impact of the role of the Project Design Department on raising the efficiency of the implementation of engineering projects adjacent to the Riyadh Metro, which contributes to the design of more integrated and sustainable policies.

Improving the quality of implementation of development projects by providing practical recommendations based on field results that support institutional coordination, reduce financial and time waste, and contribute to efficient resource management.

Raising the efficiency of planning and engineering teams by highlighting the importance of integrated management strategies, which take into account the transportation infrastructure, the requirements of the population, and the integration of urban functions within the neighborhood.

Achieving economic and social returns by enhancing the investment of areas adjacent to the metro, improving the built environment, and increasing the demand for public transport, in order to achieve the goals of urban transformation and Saudi Vision 2030.

1.4. Objectives of the study:

The study aims to analyze the impact of the role of project design management in its combined dimensions, represented in (project planning - project risk management - project cost management - project resource management) in raising the efficiency of the implementation of engineering projects by applying to the oil and gas sector in Saudi Arabia, and a set of sub-objectives branched from it:

Analyze the impact of project planning in raising the efficiency of the implementation of engineering projects by application to the oil and gas sector in Saudi Arabia.

Analyze the impact of project risk management in raising the efficiency of the implementation of engineering projects by applying to the oil and gas sector in Saudi Arabia.

Analysis of the impact of project cost management in raising the efficiency of the implementation of engineering projects by application to the oil and gas sector in Saudi Arabia.

Analyze the impact of project resource management in raising the efficiency of the implementation of engineering projects by application to the oil and gas sector in Saudi Arabia.

1.5. Study Questions

The first main question: What is the impact of the role of the Project Design Department in its combined dimensions, represented in (project planning - project risk management - project cost management - project resource management) in raising the efficiency of the implementation of engineering projects by applying to the oil and gas sector in Saudi Arabia, and several sub-questions branch out of it as follows:

- To what extent does project planning contribute to raising the efficiency of the implementation of engineering projects applied to the oil and gas sector in Saudi Arabia?
- What is the impact of project risk management in raising the efficiency of the implementation of engineering projects applied to the oil and gas sector in Saudi Arabia?
- How does project cost management affect the efficiency of the implementation of engineering projects applied to the oil and gas sector in Saudi Arabia?
- To what extent does project resource management contribute to raising the efficiency of the implementation of engineering projects applied to the oil and gas sector in Saudi Arabia?

1.6. Study assignments:

To achieve the objectives of the study and answer its questions, the researcher can rely on the theoretical framework related to the study, and based on the results of previous studies, the following hypotheses have been formulated:

The first main hypothesis : There is no statistically significant impact of the role of the Project Design Department in its combined dimensions, represented in (project planning - project risk management - project cost management - project resource management) in

raising the efficiency of the implementation of engineering projects by application to the oil and gas sector in Saudi Arabia.

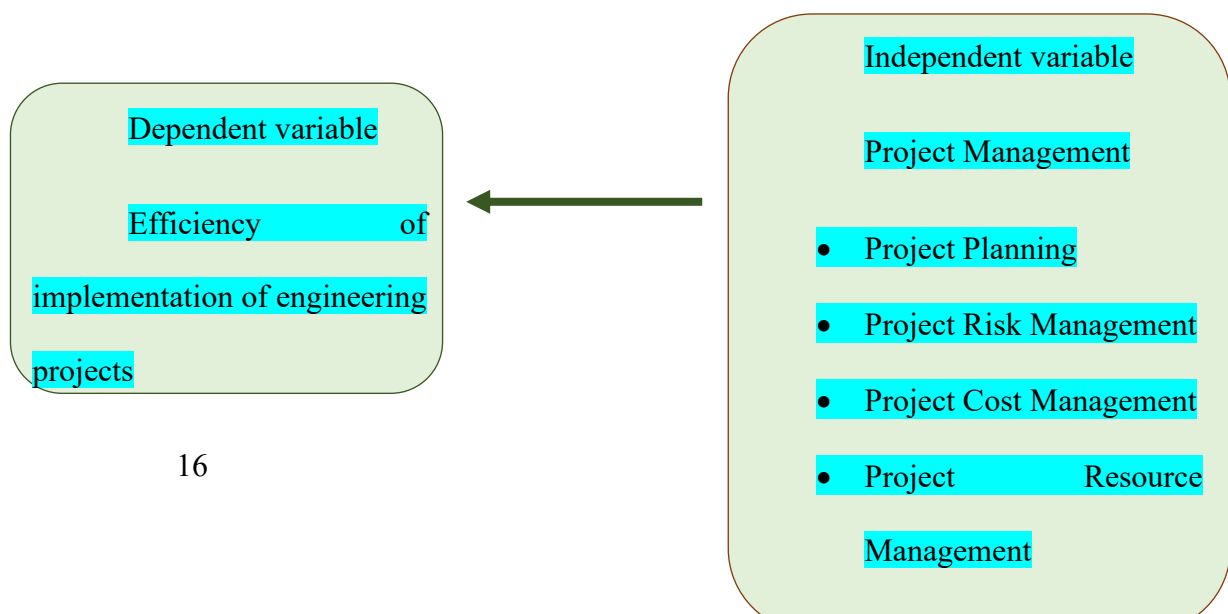
From this hypothesis emerge the following four sub-hypotheses:

- There is no statistically significant impact of project planning in raising the efficiency of the implementation of engineering projects applied to the oil and gas sector in Saudi Arabia.
- There is no statistically significant impact of project risk management in raising the efficiency of the implementation of engineering projects applied to the oil and gas sector in Saudi Arabia.
- There is no statistically significant impact of project cost management in raising the efficiency of the implementation of engineering projects by application to the oil and gas sector in Saudi Arabia.
- There is no statistically significant impact of project resource management in raising the efficiency of the implementation of engineering projects applied to the oil and gas sector in Saudi Arabia.

1.7. Study Form:

Independent variable: The role of project design management in its combined dimensions represented in (project planning - project risk management - project cost management - project resource management).

Dependent variable: Efficiency of implementation of engineering projects.



Source: Researcher work

1.8. Previous studies:

Studies on Project Design Management

A study (Baqer, 2020), entitled The Impact of Risk Management on the Role of Engineering Project Design Department: The Mediating Role of Organizational Culture in the Public Authority for Roads and Land Transport in the State of Kuwait

The current study aimed to identify the impact of risk management in its dimensions: technical risk management, logistical risk management, financial risk management, human resources risk management, social and political risk management and environmental risk management on the role of engineering project design management in its dimensions: cost, quality, time and field, through the mediating role of organizational culture in the Public Authority for Roads and Land Transport in the State of Kuwait. To achieve the objectives of the study, the descriptive analytical approach was relied on, through the design of a questionnaire and its distribution to individuals The study sample: engineers and technicians working in the Public Authority for Roads and Land Transport in the State of Kuwait through the use of simple random sample technology. The number of questionnaires distributed electronically reached (220) questionnaires, while the number of questionnaires recovered and valid for analysis reached (160) questionnaires, representing 72.72% of the total questionnaires distributed. In order to analyze the study data, descriptive statistics represented by frequencies, percentages and arithmetic averages were used, simple and multiple linear regression analysis was used, in addition to the use of PLS-SEM program to analyze and test hypotheses. The current study reached a number of results, the most important of which are: the existence of a statistically significant impact of risk management in its combined dimensions on the role of the Engineering Projects Design Department in its combined dimensions in the Public Authority for Roads and Land Transport in the State of

Kuwait, and the existence of a statistically significant impact of risk management in its combined dimensions in the organizational culture. And the existence of a statistically significant impact of the organizational culture in the role of the Engineering Projects Design Department in its combined dimensions in the Public Authority for Roads and Land Transport in the State of Kuwait. It was also found that there is a statistically significant partial impact of risk management in terms of its combined dimensions on the role of engineering project design management in terms of its combined dimensions through the organizational culture as an intermediate variable in the Public Authority for Roads and Land Transport in the State of Kuwait. In light of the results of the current study, the researcher recommends a number of recommendations, the most important of which are: Establishing electronic systems to monitor and evaluate the equipment and tools used in the project and linking them with the Quality Control Department to ensure permanent compliance with the specifications and standards followed. Reduce supply chain risks by identifying, assessing, mitigating and monitoring unforeseen events and circumstances and preparing for their negative impact on any part of the supply chain during project performance by developing risk tracking software and linking them with software for project design management role such as Primavera Linking KIMS The user in the Public Authority for Roads and Land Transport in the Audit Bureau and Financial Management to avoid any inaccurate operations and to increase the level of internal and external control. Building a database that includes most of the risks facing engineering projects at all stages of the project's life, and the most important requirements for implementing engineering project risk management in the Public Authority for Roads and Land Transport in the State of Kuwait, and how to address and avoid risks.

A study (Al-Shehri, 2024), entitled The Role of Agile Management in Supporting Knowledge Management Project Management Projects in Government Agencies in the Kingdom of Saudi Arabia: A Proposed Model

The study aimed to identify the role of agile management in supporting knowledge management projects in government agencies in the Kingdom of Saudi Arabia, and also aimed to identify the role of agile management in supporting knowledge management projects through the processes of (knowledge transfer and distribution - knowledge acquisition - knowledge application) in Saudi government agencies, as well as to identify the level of current practices of agile management through dimensions (continuous improvement, vision management, respect for individuals) and its role in supporting knowledge management projects and identifying employees' perception about the obstacles and difficulties that Faced applications of agile management in support of knowledge management projects, the study followed the descriptive survey approach, and the questionnaire was used to obtain analysis data, while the current study sample consisted of all heads of departments and senior departments working in government agencies in the Al-Baha region, numbering (42) individuals, and the questionnaire was used to collect data related to the axes of the study, and the results of the study showed the existence of a role for agile management in supporting knowledge management projects represented in the dimension of the application of knowledge followed by after the acquisition of knowledge followed by After the transfer and distribution of knowledge, the results of the study also showed the approval of the study members to a very high degree at the level of current practices of agile management through the dimensions of continuous improvement, management by vision, and respect for individuals, and that the most prominent results of the level of current practices of agile management were represented in the dimension of management by vision, followed by after continuous improvement, followed by after respect

for individuals, in addition, the results showed that there were no differences between years of experience in supporting knowledge management projects in government agencies due to variables: (Academic qualification, years of experience, employer), and the existence of a statistically significant correlation between the support of knowledge management projects through its dimensions (knowledge acquisition, knowledge transfer and distribution, and application of knowledge) and the level of current practices of agile management through its dimensions (for continuous improvement, management by vision, respect for individuals at a significant level of 0.01, the results showed a strong and statistically significant correlation between supporting knowledge management projects and modern management methods and methods, and the study recommended the need to ensure the participation of the government apparatus and the individuals working in it. Planning and implementation processes to enhance their creativity, working to take advantage of the mistakes that occur from employees and considering them opportunities for learning and continuous improvement, holding workshops to address the weak support of senior management for agile management applications, encouraging the government apparatus to adopt innovative ideas submitted by its employees because of their positive role in supporting knowledge projects, supporting the government apparatus's adoption of a clear policy to regulate the agile work environment in support of knowledge projects, and seeking solutions to the economic pressures facing workers Finally, the study presented a proposed model for the role of agile management in supporting knowledge management projects in government agencies in the Kingdom of Saudi Arabia.

A study (Abdul Nabi, 2021), entitled The Relationship of Innovation and Creativity in the Success of the Role of the Project Design Department: An Application to the Emiratization Agency at the Ministry of Human Resources and Social Development

The study aimed to identify the role of innovation and creativity in the success of the role of the Project Design Department, where the problem of the study is the main question: What is the relationship between innovation and creativity with the success of the role of the Project Design Department in application of the Emiratisation Agency in the labor sector at the Ministry of Human Resources and Social Development? The study population consists of the employees of the Tawteen Agency at the Ministry of Human Resources and Social Development, and their number is (128), and the questionnaire was distributed to them, and (128) questionnaires were retrieved with a response rate of (100%), and the study relied on the descriptive analytical approach, and it became clear from the results of the study that innovation and administrative creativity has to do with developing the framework of concepts of the innovative ability of the Tawteen Agency in providing new products, and its relationship to market performance by attracting human resources with qualifications and experience, and the Tawteen Agency innovates and creativity in projects, and accepts Change and renewal in business performance, and that the adoption of new ideas in the processes of project planning, implementation and control, organizational structure, organization and distribution, is done through continuous development and innovation of products, and that there is a relationship between creativity and innovation and between improving human resource management, and project quality management. Most projects with an innovative format were unique, which increased the chances of success. The study recommended continuous encouragement of development, innovation and the spirit of cooperation in small and medium enterprises, and more attention to workers in accomplishing tasks in creative and innovative ways, and the ability to think creatively, through creative methods of management.

A study (Lead, 2023), entitled Contributions of Network Analysis to the Effectiveness of the Role of Project Design Management: A Study of the Reality of the Public Works Sector in Tamangst State

The study aimed to highlight the reality of the contributions of network analysis to the effectiveness of the role of the Project Design Department in the state of Tamangst, in terms of the completion of construction projects on time, at the lowest cost and with the required quality, and to achieve this goal, the questionnaire was distributed on paper to 40 contractors whose main activity is public works and was processed using SPSS v23 program. The study reached several results, the most important of which is the existence of an impact of the use of network analysis on the effectiveness of the role of the construction projects design department, although most of the study sample members They do not plan, schedule and monitor their construction projects using network analysis and modern programs, which is reflected in reducing the cost of projects, the time it takes to complete them and profitability In light of the results of the study, a set of recommendations were proposed, including training workers to use and effectively control modern programs for the role of project design management.

A study (Al-Abdallat, 2021), entitled The Impact of Good Governance on the Role of Project Design Management: The Modified Role of Crisis Management Planning in the Greater Amman Municipality

This study aimed to identify the impact of good governance in its dimensions (rule of law, transparency, accountability, participation, integrity, fairness, effectiveness, efficiency and sustainability) on the role of project design management in its dimensions (quality management, schedule management, scope management, cost management, risk management and resource management) through crisis management planning as a modified variable in the Greater Amman Municipality. To achieve the objective of the study, the study

adopted the quantitative approach. The study population consisted of workers in the projects of the Greater Amman Municipality: managers, project managers and employees, which numbered (300) employees, and the comprehensive survey was used, and (258) questionnaires were retrieved. The study reached a set of results, the most important of which is the existence of an average level of importance for good governance and the role of project design and planning management management in the Greater Amman Municipality, and the existence of a statistically significant impact of good governance in the role of project design management, as well as the existence of a role for crisis management planning in improving the impact of good governance in the role of project design management in the Greater Amman Municipality. It also found that the dimensions of sustainability and effectiveness have the greatest impact on the role of project design management and its dimensions, and the sustainability dimension has the greatest impact on the existence of crisis management planning. The transparency dimension has had the opposite effect on the role of project design management as well as in the presence of crisis management planning. The study recommended a set of recommendations, the most important of which are: the need for the Greater Amman Municipality to continue to apply and evaluate good governance, with continuous awareness of its employees about the dimensions of good governance, and work to spread the culture of governance in the Municipality, while continuing to develop strategies that ensure the provision of services to all target groups in accordance with social justice and without discrimination, and giving everyone equal opportunities, and the need to develop performance indicators to measure the dimensions of the role of the project design department in the projects implemented in the Municipality, as well as appointing specialized teams for crisis management and others for risk management. And the work of a special guide in the governance of rational projects is applied in governmental and private

organizations with the need for a body responsible for following up the application and conducting a similar scientific study in the private sector.

Infrastructure Studies

A study (Alnsour, 2023), entitled A Sustainable Urban Design Model for Residential Neighborhoods: Palestinian Context

This study aimed to develop an integrated model for sustainable urban design of residential neighborhoods in Palestine, based on the analysis of international sustainability assessment tools such as NSA. The researchers used GIS and Urbano tools along with , interviews and observation, to identify local measurement indicators that take into account the climatic and social specificity of the Palestinian context. The results showed that the integration of the natural environment, energy and water infrastructure, and community activities leads to enhancing the efficiency of neighborhoods and reducing environmental impact. The study recommends the adoption of an institutional sustainability index for local neighborhoods that takes into account the environment, economy, and social scope as .balanced pillars

Karaman (2022) study titled Residential Satisfaction and Quality of Urban Life: Examining Diverse Housing Environments in Kayseri, Turkey

In a comprehensive study of residents of Kayseri district in Turkey, the researchers examined the relationship between the type of residential environment (high density versus ,low) and quality of life. Data from 600 households were collected using a questionnaire then analyzed across multiple regression andANOVA The results proved that the . satisfaction of residents is more severe in low-storey neighborhoods compared to high, as the presence of nearby urban services and social relations between neighbors enhances the ,sense of belonging, and therefore quality of life. The study concluded that the psychological social and structural dimensions should be taken into account when designing

neighborhoods, and called for improving the level of urban services in high-density neighborhoods

A study (Mouratidis, 2022), entitled *What Makes Cities Livable? Determinants of Neighborhood Satisfaction and Happiness in Thessaloniki and Oslo*

The researchers led a comparative study in two European cities, based on structural factor analysis on survey and geographical data from the city's population. The results highlighted that proximity to the urban center, safety and belonging to the place are common factors that raise the degree of satisfaction. Happiness is also associated with calmness, social cohesion and low density. The team found differences between the two cities: the parks did not contribute much to the satisfaction of the residents of Thessaloniki, but they did in Oslo. They recommended including both residents' motor and emotional satisfaction in urban planning, to raise the quality of life and the positive impact of sustainable planning

A study (Hassan, 2023), titled *Neighborhood Connectivity and Social Sustainability: A Case Study of Qasimabad, Hyderabad*

The researchers reviewed the case of the Qasimabad district of Hyderabad highlighting the importance of the road network and public spaces in promoting the social sustainability of neighborhoods. They found that rapid population growth without a planning structure causes urban randomness that negatively affects social cohesion and quality of life. Through a literature analysis and a field questionnaire, the researchers identified nine characteristics of a sustainable neighborhood, including spatial proximity, inclusivity, service access, community communication, and local governance. They stressed that enhancing structural and social communication within the neighborhood reduces isolation and increases the satisfaction and continuity of residents in the neighborhood

Study (Lee, 2021), entitled *Relationship between Physical Environment Satisfaction, Neighborhood Satisfaction, and Quality of Life in Gyeonggi, Korea*. *Land*, 10(7), 663–675.

The study aimed to analyze the relationship between residents' satisfaction with the physical environment of the neighborhood (such as streets, services, green spaces) and their overall satisfaction with the neighborhood and quality of life. Data from a national survey conducted in Gyeonggi Province, Korea, involving 20,000 participants was used in a multi-stage stratified design. The results of the Working Regression Analysis and ANOVA showed that residents' satisfaction with the physical environment of their service – such as the availability of amenities and the safety of the area – is positively and consistently correlated with overall quality of life. A moderate effect analysis also showed that the level of satisfaction About the neighborhood enhances the positive impact of environmental satisfaction in enhancing the quality of life, which expresses the role of the relationship between the individual and his environment. The results suggest that neighborhood planning should focus on improving the quality of infrastructure and services and taking into account safety and comfort requirements to achieve a tangible improvement in residents' satisfaction and quality of life.

1.9. Research Gap:

A review of previous studies on the role of project design management, functional integration and raising the efficiency of engineering project implementation shows that there is a richness in research efforts that addressed each of them separately, but at the same time reveals a clear research gap regarding the interconnectedness of these axes in rapidly growing national urban contexts, such as in the Riyadh metro project and adjacent residential areas.

Most of the previous studies intersect in their interest in analyzing the elements of administrative and field performance in the role of project design management (as in the studies of Abdul Nabi, 2021; Abdallat, 2021; and Taqda, 2023), focusing on traditional variables such as innovation, governance, and network analysis. Despite the scientific importance of these studies, they mostly focused on administrative or construction sectors

without direct link to the development of residential neighborhoods adjacent to large urban transport projects such as the metro. Most of these studies relied on typical management models without looking deeply into the urban environment as a changing and multidimensional field.

On the other hand, data protection studies (such as Karaman, 2022; Mouratidis, 2022; Hassan, 2023) have focused on elements of housing satisfaction, social sustainability, and urban quality, but have not integrated the tools of the role of project design management as a governing mechanism in neighborhood development processes, nor have they considered how these tools can be used within the contexts of transformational development resulting from major national projects such as the metro. Also, these studies have mostly focused on cities outside the Arab world, limiting the possibility of generalizing their findings to Gulf urban environments with cultural and demographic specificity, such as Riyadh.

The current study, which examines **the role of project design management in raising the efficiency of engineering project implementation**, offers a unique treatment in terms of combining the tools of the role of traditional project design management with urban development goals within a national transformation framework. It differs from previous studies in its orientation towards **integrating the planning and administrative dimension with the urban transformation dimension in a modern and complex context**. The study is also distinguished by its targeting of a specific geographical location of strategic importance at the national level, which is the vicinity of the Riyadh metro project, which is one of the largest urban transport projects in the Middle East. This overlapping and accelerating context of transformation has not been addressed in depth in previous Arab or foreign studies.

Accordingly, the research gap is highlighted in the fact that the current study focuses on activating the role of project design management as a strategic tool to guide raising the

efficiency of the implementation of engineering projects affected by national projects, and evaluating the effectiveness of this activation at the administrative and urban levels, which was not addressed by previous studies that were limited to either administrative or residential contexts in a fragmented manner.

1.10. Theoretical premises of the study:

The current study, titled "The Role of Project Design Management in Raising the Efficiency of Engineering Projects Implementation: An Applied Study on the Oil and Gas Sector in Saudi Arabia", relies on a number of theoretical premises that constitute the intellectual and cognitive framework on which it is based in analyzing the studied phenomenon and understanding its dimensions.

At the forefront of these premises comes the comprehensive concept of the role of project design management, as an organizational and strategic tool used to plan, implement and monitor projects, by applying knowledge, skills, tools and techniques to project activities to achieve its objectives effectively. This concept has evolved to include new areas such as urban transformation, where it is no longer limited to technical and construction aspects, but includes social, economic and environmental dimensions that affect urban communities and the ways of life of residents.

The study is also based on urban planning literature that places raising the efficiency of the implementation of engineering projects at the heart of urban transformation processes, especially in light of the growth of national projects such as mass transit projects. Neighborhoods adjacent to metro stations are seen as strategic urban environments, affected by functional and structural changes as a result of convergence with major transport hubs, which calls for an integrated management approach to develop them according to quality, sustainability and urban suitability standards.

The study theoretically frames the concept of urban transformation as a dynamic process that includes the restructuring of urban spaces, by directing investment, improving infrastructure, and raising the quality of life, while preserving the cultural and social specificity of the population. In this context, the role of the Project Design Department intersects with the urban transformation in creating effective management tools that contribute to improving the urban performance of neighborhoods, which this study seeks to monitor and analyze in the reality of the city of Riyadh.

On the other hand, the study proceeds from the premise that major transport projects, such as the Riyadh Metro project, are not only transportation infrastructures, but are catalysts for large-scale urban transformation, which directly and indirectly affect the planning and raising the efficiency of the implementation of neighboring engineering projects. Therefore, the management of urban development projects in these neighborhoods requires advanced models of governance, stakeholder engagement, and coordination between executive authorities and local communities, all of which establish the important role played by the role of the Project Design Department in controlling this transformation.

Based on the above, the current study bases its theoretical framework on integrating the concepts of the role of urban project design management and urban transformation, taking into account the unique Saudi context, and the challenges posed by the National Vision 2030, including the trend towards improving the quality of life and activating economic and social mobility in major cities such as Riyadh.

1.11. Methodology and Research Methods:

The descriptive approach and the analytical approach were followed as an appropriate method of description, which corresponds to the theoretical chapters, either in the applied analytical chapter and the deductive method in order to analyze and evaluate the data obtained in the questionnaire of the institution under study as appropriate for determining the

facts and understanding the components of the subject, while subjecting it to careful study and analysis of its dimensions, which we will address in the applied chapter in the case study.

The choice of the appropriate approach to the nature of the research depends on the nature of the problem and the goal of its study, and in order to take note of the various aspects of the study, the descriptive analytical approach will be relied on, the descriptive method is suitable for the description that matches the theoretical chapters, but in the applied analytical chapter and the deductive approach in order to analyze and evaluate the data obtained in the questionnaire under study, as this approach contributes to answering research questions through data collection and then analysis and discussion. This approach is used in most previous studies.

1.11.1. Sources of data collection

- **Secondary sources:** These include data and information in books and references, theses, working papers, journals, periodicals, scientific conferences and workshops, in addition to published and unpublished reports that dealt with the topic in various relevant institutions.
- **Primary sources:** The study relied on the questionnaire as the main tool in collecting data from its sources, which was specially designed for this purpose on Google Forms and sending its link to the research community.

1.11.2. Study Tools:

The research tool is defined as "the means by which the data collection process is carried out in order to answer his questions, and researchers will rely in collecting data on the questionnaire, which is defined as "a specific form of paragraphs and questions aimed at collecting data from research individuals"

It consisted of two main sections:

- **The first section:** It is the part related to the demographic variables of the members of the study sample, represented by: gender, age, educational qualification, and job level.

- **Section II: The** second section included paragraphs and dimensions that measure the variables of the independent and dependent study.

1.11.3. Statistical methods used

The following statistical methods were used to achieve the objectives of the study:

- Cronbach alpha coefficient to measure the stability of the study tool and Pearson's correlation coefficient to measure the validity of the study tool and the relationship between variables
- Frequencies, percentages, arithmetic mean and standard deviation related to the study variables and to all responses to the questionnaire paragraphs.
- Simple linear regression coefficient to measure the effect of each dimension of the independent variable on the dependent variable

1.11.4. Study Tool

The questionnaire in the current study is designed to suit the variables of the research by reviewing previous studies related to the subject of the study. The questionnaire consists of two main sections:

The first section: deals with the demographic variables of the study sample of workers in the construction projects sector, and includes job title, age, educational level, and number of years of experience.

The second section: contains the paragraphs that measure the independent and dependent variables in the study.

First: The independent variable - the role of project design management, measured through 20 paragraphs divided into three main dimensions:

- Project Planning
- Project Risk Management
- Project Cost Management

- Project Resource Management

Second: The dependent variable - raising the efficiency of the implementation of engineering projects, measured through (10) distributed paragraphs.

Limitations of the study:

Objective limits: The study is limited to analyzing the impact of the role of project design management in its combined dimensions, represented in (project planning - project risk management - project cost management - project resource management) in raising the efficiency of the implementation of engineering projects by applying to the oil and gas sector in Saudi Arabia.

Spatial boundaries: The study is conducted on the oil and gas sector in Saudi Arabia.

Time limits: The study was prepared in 2025.

Human limits: The human limits of this study are limited to those working in the oil and gas sector in Saudi Arabia.

CHAPTER ONE:

LITERATURE REVIEW

Introduction to the Chapter

This chapter is structured to cover the theoretical, empirical, and contextual literature pertaining to the contribution of Project Design Management (PDM) to the improved construction of engineering projects, especially in the oil and gas industry in Saudi Arabia. It anchors to the fundamentals of project management and merges available global and regional research to derive the study's hypotheses and conceptual model.

In the oil and gas industry and other highly capital intensive and multi-disciplinary integrated engineering sectors, PDM has become an organizational capability of central importance. Its importance is derived from the fact that planning, risk management, cost control, and resource management optimization to meet organizational objectives are all ‘heavy-weight design management issues.

This literature review will address the following objectives: (1) outline the theoretical approaches to design management and implementation efficiency, (2) assess the extant literature within and outside the GCC, (3) develop a research model that conceptually associates the independent and dependent variables, and (4) address the deficiency in the existing literature that the research will cover.

1.12. Concept of Project Design Management (PDM)

In simple terms, Project Design Management (PDM) is the process of defining outline goals of a project and formulating them into a comprehensive plan that addresses scope, cost, risk, and resource integration and allocation. It branches technical and managerial aspects of a project and seeks to achieve the result within the set constraints of budget, time, and other

relevant factors. As per the definition of Project Management Institute (PMI) (2021), PDM is a project management phase where systematic application of knowledge, skills, tools, and project management techniques on a project activity is done such that stakeholder values are earned or maximized.

According to Baqer et al. (2020), PDM is an integrative function that connects strategic intent with operational execution via design planning that is coherent and cross-functional. In large and complex projects that are common in the oil and gas industry, spanning several years and involving multiple international partners, PDM integrates the engineering, procurement, and construction (EPC) phases to comply with safety and quality standards.

Abdul Nabi and Al-Otaibi (2021) assert that PDM incorporates innovation and adaptive decision making in every design step, going beyond administrative planning. It corresponds with PMBOK 7 principles on integration and iterative feedback, stakeholder collaboration, and agile change.

This enables and constrains behavior so that engineering organizations can efficiently deliver projects in the face of technological complexity, safety uncertainties, and regulatory challenges.

1.13. Core Dimensions of PDM

There are four interrelated dimensions that underpin the operational success of project design management in PDM:

1. Planning – is the process of defining the project scope, deliverables, milestones, and stakeholder expectations. It is the basis for resource and timeline alignment. Effective planning may decrease ambiguity and improve readiness for execution (Al-Shehri and Al-Aqili 2024).

2. Risk – is the process of identifying, analyzing, and mitigating uncertainties that may block progress. In engineering, there is the technical, financial, and environmental risks (Maali & Al-Dabbas 2022). Effective risk management frameworks are focused on mitigation, not correction.

3. Cost – through systematic cost estimation, allocation, control, and performance monitoring, project costs are maintained within the budget. Cost control is especially critical in volatile energy commodity markets. Al-Azzawi and Al-Jubouri (2022).

4. Resource management deals with the distribution and the maximization of people, materials, and technology. Al-Abdallat and Al-Shura (2021) point out that a well structured system of resources minimizes the system downtimes and enhances the workflow integration of various divisions.

All these elements, when put together, create an interdependent system that dictates the overall efficiency of a project. In the oil and gas industry, which is highly sensitive to risks, even the smallest discrepancies in these elements can lead to expensive delays or safety issues.

1.14. Efficiency in Engineering Project Implementation

Project efficiency in general can be defined as the accomplishment of particular goals in a specified time, with given resources, and without compromising the quality. As said by Lee, the one who focuses on the topic the most, efficiency is the equilibrium of the put in resources, and the results reaped. As Kerzner, 2023 says, efficiency is the planned performance versus actual results, where the difference is defined as a failure or a lack of balance in a systemic function or management.

In the fast-growing oil and gas industry of Saudi Arabia, project efficiency is considered crucial to the country's Vision 2030 goals, which emphasizes on cost effective measures, digitalization, and sustainable growth (Ministry of Economy and Planning, 2023).

Increasing project efficiency enhances the country's competitiveness and decreases the reliance on foreign subcontractors which in turn supports the local content policies.

Achieving efficiency is, therefore, not an operational aim, but a primary strategy that supports the project's optimization for the country's critical national infrastructure and industrial transformation.

1.15. . Supporting Theories

The relationship between PDM and efficiency can be understood through several theoretical lenses:

1. Systems Theory (Bertalanffy, 1968): Views projects as subsystems embedded in larger organizational and societal systems. The efficiency of each subsystem rests upon integration and feedback systems between the system's design, implementation, and evaluation.

2. Resource Based View (RBV) (Barney & Hesterly, 2023): Sustained performance advantage comes from an organization's distinctive design management capabilities, which rivals are not able to easily replicate.

3. Lean Management Theory (Womack & Jones, 2022): Waste elimination and value maximization through ongoing enhancement. In PDM, this includes design review cycles, sequential task workflows, and performance evaluations.

4. Contingency Theory (Al-Shehri & Al-Aqili, 2024): The effectiveness of project management practices depends on the project size, technological uncertainty, and cultural considerations.

The integration of these theories demonstrates PDM's effectiveness in implementation through an accomplished, oriented, adaptive, and lean resource system.

1.16. Empirical Studies

1.16.1. Studies in the GCC and Middle East

Many studies in the Gulf Cooperation Council (GCC) region reinforce the importance of PDM to the operations of both public and industrial projects.

Baqer et al. (2020) highlighted comprehensive risk management's positive impacts on outcomes within organizational culture at Kuwait's Public Authority for Roads. Their research identified the significance of digital systems for monitoring construction progress such as Primavera and KIMS.

Al-Shehri and Al-Aqili (2024) researched the impact of agile management on knowledge management projects in the public sector. In public agencies, they showed how iterative planning along with participatory management improved the core knowledge and innovation cycles, thereby, contributing to agile PDM.

Abdul Nabi and Al-Otaibi (2021) demonstrated the impact of creativity and innovation on projects in the Ministry of Human Resources and Social Development, indicating that organizational creativity leads to greater efficacy and dedication from employees.

Al-Abdallat and Al-Shura (2021) studied the impact of governance on the design management of some municipal projects in Amman. Predictors of success in its implementation responsiveness and resiliency showed governance mechanisms strengthen the impact of PDM.

Qada and Dawi (2023) proved the results of network analysis to the public works in Algeria and showed that network analysis improves monitoring precision and minimizes expenditure drawbacks, therefore, showed the use of digital tools enhances design control.

In the context of oil and gas sector, Al-Dhafiri and Al-Shura (2021) investigated the impact of strategic synergy and empowerment on success of project design at the Kuwait Oil

Company and found that empowered teams had better compliance with safety and design requirements.

At last, Hassan and Qureshi (2023) emphasized that, in Saudi Arabia, project efficiency increases with the implementation of systems of integration and inclusivity in the management, which, in turn, exemplifies the social sustainability feature of engineering projects.

1.16.2. International Studies

At the international level, numerous studies corroborate the positive relationship between structured design management and implementation performance.

Mouratidis and Poortinga (2022) undertook a comparative study focusing on Oslo and Thessaloniki and deduced that project success and livability outcomes increase due to stakeholder collaboration and adaptable design frameworks. In a parallel manner, Karaman and Karaman (2022) discovered that design intended to be at the center of user activity and interaction increases stakeholder satisfaction and the longevity of projects, which can also be applied to industrial design.

In the European Union infrastructure, Turner and Müller (2023) showed that design management by certified specialists correlates with better performance with project schedules and budgets. Berssaneti et al. (2022), using data from 84 engineering firms, found that risk management maturity accounts for 47% of the variance of project outcomes.

Ding et al. (2024) found that, in regard to Saudi projects, AI-integrated Building Information Modeling (BIM) assists in maintenance forecasting and improves collaboration across other fields. In the case of the UAE, Ibrahim and Al-Saleh (2024) noted a reduction of 21 % in rework processes and an improvement of 15 % in safety records after the implementation of digital PDM.

Liu et al. (2023) examined petrochemical projects in Asia and argued that incorporating proactive cost-risk integration tends to alleviate delays and increase stakeholder satisfaction. On the other hand, Smith and Reich (2022) focused on the role of leadership and how communication assists in the conversion of design work to operational effectiveness in OECD countries.

All of these have shown that PDM, particularly digital, collaborative, and leadership driven PDM, produces positive results in efficiency, safety, and sustainability of work PDM on a global scale.

1.17. Saudi Vision 2030 and Industrial Literature

“While diversifying the economy and enhancing the effectiveness of the public sector, the Project Design Management of Vision 2030 assigns special importance to the oil and gas sector extending PDM to cover sustainability, localization, and digital transformation (Saudi Ministry of Energy, 2023).”

“Adoption of digital dashboards, unified design templates, and automated scheduling across Aramco and SABIC projects has reported an increase of 33 % in efficiency of the project cycle (NCPM, 2024).”

As noted in the Vision 2030 Annual Report (2023), project governance reforms increased completion rates from 64% in 2020 to 81% in 2023. However, the persistent issue of inadequate resource allocation indicates the need for tailored PDM frameworks.

In a study of Saudi construction mega projects, Al-Qahtani (2022) claimed that the participatory design review approach reduces costs by as much as 25%. On the other hand, Al-Harbi (2024) illustrated the increased effectiveness of the upstream portfolio of Saudi Aramco through the integration of design at the early stages and through risk-sharing contracts.

Together, these works form a rich contextual background from which it can be argued that sound design management is critical for achieving the objectives of Vision 2030 for Saudi Arabia's energy ecosystem.

Capturing from the reviewed theory and empirical evidence, the operationalized conceptual model for this study assumes that Project Design Management (PDM through planning, risk management, cost management, and resource management), PDM's four core operational dimensions, will have a direct positive effect on the Productivity of Engineering Project Implementation in the Oil and Gas Industry of Saudi Arabia.

1.18. Hypotheses

H1: Project Planning → Efficiency of Implementation

H2: Project Risk Management → Efficiency of Implementation

H3: Project Cost Management → Efficiency of Implementation

H4: Project Resource Management → Efficiency of Implementation

each PDM dimension contributes uniquely but synergistically to efficiency outcomes. Organizational culture, leadership style, and technological readiness act as contextual moderators. This reasoning aligns with **RBV** (PDM as a unique internal capability), **Systems Theory** (integration of subsystems), and **Lean Management** (continuous improvement).

Empirical validation arises from **Baqer et al. (2020)**, **Al-Shehri and Al-Aqili (2024)**, and **Ding et al. (2024)**, who all demonstrate statistically significant relationships between structured design processes and successful project implementation.

1.19. Research Gap Summary

Despite the growing literature on project management, several gaps persist concerning the role of PDM in enhancing engineering project efficiency—particularly in **For Saudi Arabia and its Oil and Gas Sectors:**

1. Contextual Gap – Baqer (2020), Al-Abdallat (2021), and other Middle Eastern researchers view public and municipal works projects as the primary focus of their inquiries. These works often ignore the more perilous and intricate industrial settings.

2. Methodological Gap – Just about every study that has been published has thus far used sample sizes (the number of individual observations or replicates used) less than 200, or qualitative methodologies. A study that has used quantitative methodologies with 400 participants, advanced statistical analysis, and has published results, is sorely lacking.

3. Variable Gap – These earlier works tend to be focused and single a single variable, such as risk or cost. There has yet to be a study that integrates all four dimensions of Project Decision Management (PDM) into a cohesive framework.

4. Geographical Gap – Much of the international evidence, such as Turner & Muller (2023) and Liu et al. (2023), draws its context from the West or East Asia, both of which are vastly different in their institutional arrangements to the centralized Saudi Arabia.

5. Practical Gap – There is a dearth of empirical evidence that connects PDM practices to its resulting measures of efficiency: time, cost, quality, and safety, particularly in the context of Saudi energy projects.

The current study aims to fill these gaps via the formulation and rigorous quantitative testing of a PDM-efficiency model. The results are intended to optimize the design of managerial and policy frameworks in line with the 2030 vision of Saudi Arabia which aims at operational excellence with sustainable growth.

CHAPTER THREE: METHODOLOGY

Chapter Overview

The focus of this chapter is conceptual framework ‘how to’ PDM Through project planning, risk management, cost management, and resource management, the efficiency of implementation of engineering projects within the oil and gas sector of Saudi Arabia. This study is conducted through the use of a quantitative, descriptive–analytical approach and utilizes a five-point Likert scale administered to a sample of 400 respondents. This chapter covers research design, sample and population, data collection, research tool construction and validation, data interpretation, ethical concerns, and the scope of the study.

1.20. Research Design

The research utilizes a cross-sectional quantitative method to find and describe relationships and patterns among the given variables.

This method is suitable for the cross-section of the population because it allows the collection of standardized data, which can be reliably tested and analyzed quantitatively within a given period.

The study is described through the summary characterization of responses given and the perceptions held and analyzed for the derivation and validation of hypotheses.

1.21. Population and Sampling

The population of interest consists of employees engaged in the engineering, design, planning, construction, operation, and maintenance phases of oil and gas projects in Saudi Arabia.

1.21.1. Inclusion Criteria

Professionals with full time and contractual positions with 6-month working experience with oil and gas projects in Saudi Arabia.

Positions include project managers, engineers, planners, cost controllers, HSE officers, procurement officers, and site supervisors.

1.21.2. Exclusion Criteria

Interns, and administrative personnel who do not work in Saudi project operations, as well as other lower staff not associated with projects.

1.22. Sampling Strategy

A stratified purposive sampling approach was used in order to include participants from various organizational levels, as well as different regions (e.g. owners, contractors, consultants, and service providers). Within each of these categories, participants were identified through convenience and referral sampling to select individuals with appropriate project experience.

1.22.1. Sample Size

This study aimed at 400 participants, which is an adequate target to achieve reliable results, as well as for representing professionals from various regions and categories of projects.

1.23. Variables and Definitions

Independent Variable: Project Design Management (PDM)

- Project Planning: setting objectives, deliverables, and schedules.
- Risk Management: identifying, assessing, and mitigating project risks.
- Cost Management: estimating, budgeting, and controlling costs for a project.
- Resource Management: qualitative and quantitative management of human, material, and tech resources.

Dependent Variable: Implementation Efficiency

Refers to a project's capability to meet the timing, spending, and quality parameters without over excessive rework and with good level of coordination.

Control Variables (if applied): organization type, project type, geographical region, organizational level, and corresponding work experience.

1.24. Research Instrument

The study employs a complete enumeration method with the primary instrument being a survey questionnaire.

Section A. Respondent demographic profile (gender, age, level of education, current position, years of experience, type of organization, type of project undertaken).

Section B. Thematic areas of PDM and the efficiency of PDM implementation with the use of a modified five-point Likert Scale (1 = Very Low and 5 = Very High).

Items and Content

The survey tool designed consists of 25 questions with five questions representing the five key areas.

“Before the execution of a project, project objectives and the scope of work are defined, then, a plan of action is developed.”

“During the duration of the project, a risk register is developed, and continuous monitoring and updates are undertaken.”

“Costs incurred are systematically reviewed and analyzed with the budgeted costs.”

“Funds are injected to achieve the scheduled objectives.”

“Projects are completed within the agreed time and budget.”

The higher the score, the higher the level of agreement and the higher the level of characteristics being researched.

1.25. Validity and Reliability

The questionnaire was reviewed for clarity, relevance, and thoroughness by a panel of academic scholars and practitioners in project management and the oil and gas sector.

Changes to the questionnaire were also proposed in respect to the sector's wording and phraseology, and to align with the work of other scholars.

Reliability

Each construct under examination was ascertained and bounded by its meaning and concept of its primary use. Internal Constancy Reliability was assessed by the Cronbach's Alpha method. A score of 0.70 or above was said to be acceptable.

1.26. Data Collection Procedures

Questionnaires were sent electronically and were peer-reviewed through professional contacts, remote facilities, and inter-departmental divisions in oil and gas companies. Responses of each subject were preceded by a short greeting, the rationale for the headings, a description of the objective, and a cautionary note about the voluntary nature of the work.

Adequate intervals were given in the collection of responses, and to provide a longer time for engagement and responses, the stated time period for collection was set for multiple weeks. Gentle reminder nudges were sent at intervals.

1.27. Data Processing and Analysis

A careful review of the data was done, and relevant data was coded and computed into the given data analysis program. Invalid answers and those deemed incomplete were excluded from the dataset.

1.28. Analysis Plan

Underlying Principles of Analytics: Used to summarize the demographic data and the mean scores for each of the variables.

Reliability Analysis: Internal constancy was assessed through the use of Cronbach's Alpha.

1.28.1. Correlation Analysis:

Examine the inter-relationships among various dimensions of PDM and its efficiency in implementation.

1.28.2. Regression Analysis:

Determine the influence of every dimension of PDM in relation to its efficiency in implementation.

These assessments assist with attempting to explain, and even confirm, the particular objectives of the study.

1.29. Ethical Considerations

Data collection did not commence until the appropriate institution had granted HOD approval, as is required within the institution.

Respondents were informed about the objectives of the research, the confidentiality of the data, the voluntary nature of the study and the right to withdraw from the study any time. The data were anonymized, and the data were saved in a secure environment for scholarly research only.

Chapter Summary

In this chapter, the objectives of the research were outlined, along with the methodology applied, which included the design, collection, and the particular methods of data and information analysis employed.

The integrity of the research is maintained as it was completed in a consistent and dependable manner.

The following chapter will detail the findings and the analysis applied to evaluate the assumed connections between the management of project design and the efficiency of its implementation.

CHAPTER Four: RESULTS AND DISCUSSION

Introduction

This chapter analyzes the outcomes from the quantitative analysis aimed at discovering the effects of Project Design Management (PDM) on the effectiveness of implementing engineering projects in the oil and gas of Saudi Arabia. Information was solicited from 400 people all categorized as project managers, engineers, planners, cost controllers, and technical supervisors from prominent energy corporations. These descriptive statistics, reliability tests, correlation assessments, and the regression analyses aimed at answering the hypotheses presented will all be a part of the analysis.

1.30. Response Rate

Out of the 430 questionnaires distributed electronically, 400 questionnaires that met the criteria for accuracy and completeness were set aside for final analysis after the document was unscreened, giving a 93% response rate. The response rate suggests that the professionals in the oil and gas sector in Saudi Arabia are willing to contribute to projects more than others, which may be the result of the focus of the 2030 Vision transformation framework on project delivery efficiency and increased digitization.

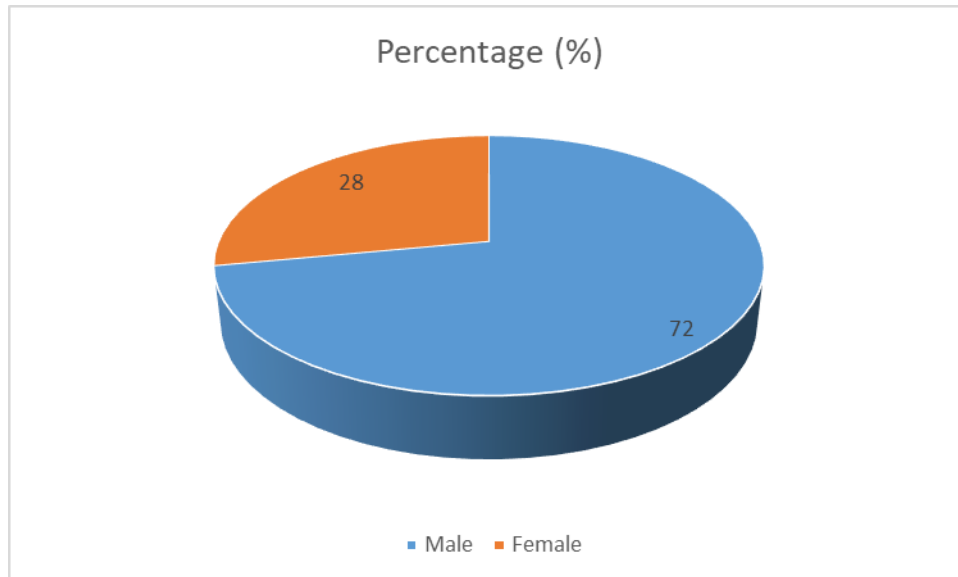
1.31. Demographic Characteristics of Respondents

A total of 400 valid responses were analyzed. Tables 4.1–4.5 present the demographic characteristics of the respondents, showing the diversity in gender, age, education, experience, and professional roles.

Table 4.1: Gender Distribution of Respondents

Gender	Frequency	Percentage (%)
Male	288	72.0

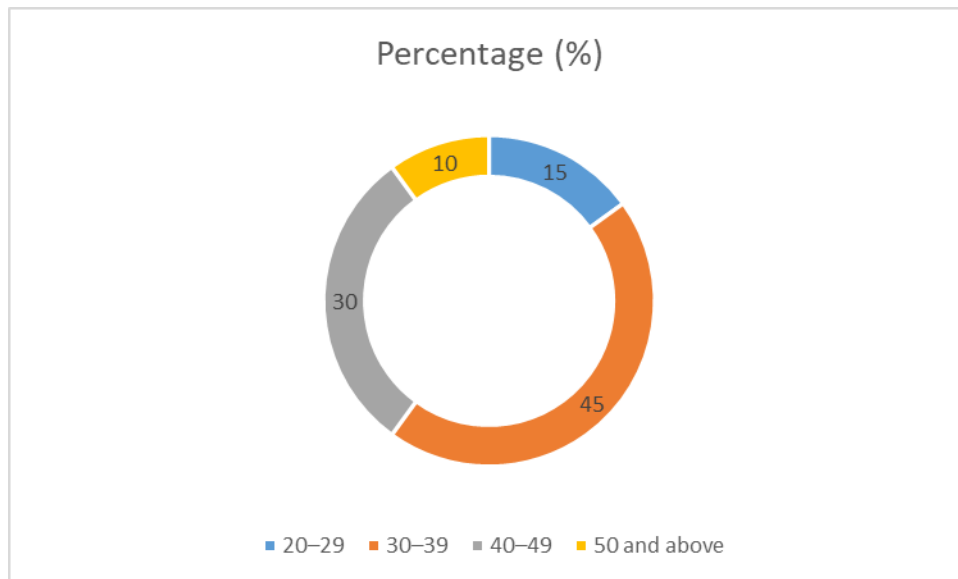
Female	112	28.0
Total	400	100.0



The sample reflects the gender composition typical of Saudi Arabia's oil and gas industry, where male professionals form the majority workforce.

Table 4.2: Age Group of Respondents

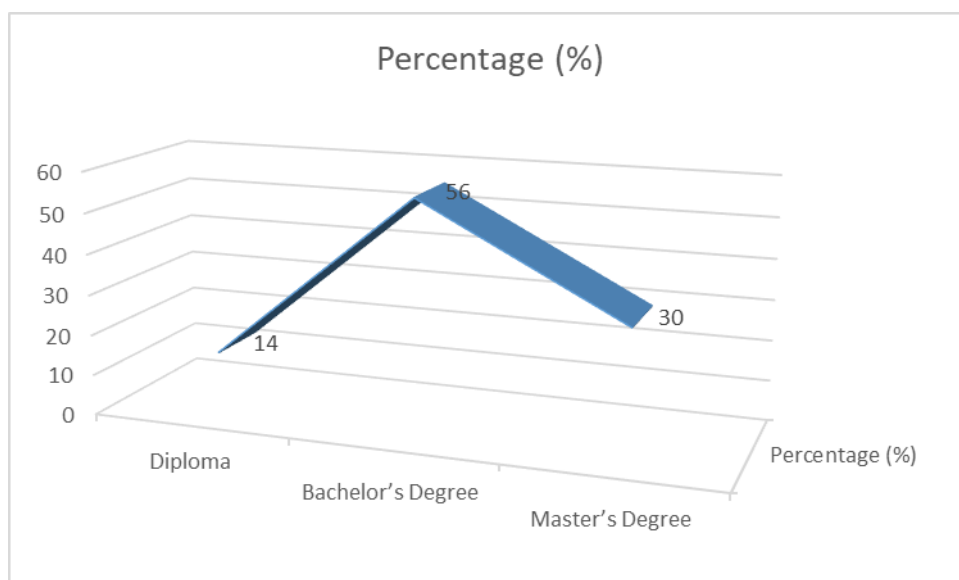
Age Group (Years)	Frequency	Percentage (%)
20–29	60	15.0
30–39	180	45.0
40–49	120	30.0
50 and above	40	10.0
Total	400	100.0



Most participants are mid-career professionals aged 30–49 years, representing experienced personnel engaged in key project management and technical roles.

Table 4.3: Educational Qualification of Respondents

Qualification	Frequency	Percentage (%)
Diploma	56	14.0
Bachelor's Degree	224	56.0
Master's Degree	120	30.0
Total	400	100.0



The majority hold at least a bachelor's degree, indicating a technically skilled and academically qualified workforce.

Table 4.4: Work Experience of Respondents

Years of Experience	Frequency	Percentage (%)
Less than 5 years	48	12.0
5–10 years	104	26.0
More than 10 years	248	62.0
Total	400	100.0

A majority (62%) have over ten years of experience, showing that the data were obtained from seasoned professionals capable of providing valid assessments of project management practices.

Table 4.5: Professional Role of Respondents

Position / Role	Frequency	Percentage (%)
Engineer	152	38.0
Project Manager	100	25.0
Cost Control	80	20.0
Site Supervisor	68	17.0
Total	400	100.0

Engineers and project managers form the largest segments of respondents, ensuring that opinions reflect both technical and managerial perspectives.

The sample seems to be reflective of and balanced within the oil and gas sector of Saudi Arabia. Respondents are mainly professionals in the mid-career stage, holding advanced degrees and having considerable experience in engineering-related and

management positions. This retention of study participants enhances the credibility of the findings and their usefulness in practice.

1.32. descriptive analysis

Table 4.6: descriptive analysis for All Questionnaire Items (N = 400)

Variable / Item	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Total (%)
Project Planning						
1. Project objectives and scope are clearly defined	8 (2.0%)	20 (5.0%)	48 (12.0%)	20 0 (50.0%)	124 (31.0%)	10 0%
2. Project schedules and milestones are properly established	10 (2.5%)	24 (6.0%)	60 (15.0%)	19 0 (47.5%)	116 (29.0%)	10 0%
3. Stakeholders are involved in the planning stage	12 (3.0%)	32 (8.0%)	72 (18.0%)	18 0 (45.0%)	104 (26.0%)	10 0%
4. Project plans are updated regularly	8 (2.0%)	28 (7.0%)	80 (20.0%)	18 0 (45.0%)	104 (26.0%)	10 0%

5.	10	26	64	19	108	10
Coordination meetings are held consistently	(2.5%)	(6.5%)	(16.0%)	2 (48.0%)	(27.0%)	0%
Risk Management						
6. Risks are identified early in the project lifecycle	16 (4.0%)	28 (7.0%)	68 (17.0%)	18 8 (47.0%)	100 (25.0%)	10 0%
7. A risk register is maintained and updated	12 (3.0%)	30 (7.5%)	76 (19.0%)	18 2 (45.5%)	100 (25.0%)	10 0%
8. Risk responses are implemented promptly	10 (2.5%)	34 (8.5%)	80 (20.0%)	18 4 (46.0%)	92 (23.0%)	10 0%
9. Management supports risk mitigation efforts	8 (2.0%)	30 (7.5%)	84 (21.0%)	18 8 (47.0%)	90 (22.5%)	10 0%
10. Lessons learned are documented to prevent risks	14 (3.5%)	28 (7.0%)	86 (21.5%)	18 2 (45.5%)	90 (22.5%)	10 0%

Cost Management						
11. Budget estimates are accurate and realistic	10 (2.5%)	24 (6.0%)	64 (16.0%)	19 2 (48.0%)	110 (27.5%)	10 0%
12. Actual costs are tracked and reported regularly	6 (1.5%)	20 (5.0%)	66 (16.5%)	19 4 (48.5%)	114 (28.5%)	10 0%
13. Cost deviations are analyzed and corrected	8 (2.0%)	24 (6.0%)	68 (17.0%)	19 0 (47.5%)	110 (27.5%)	10 0%
14. Procurement aligns with cost and design objectives	10 (2.5%)	30 (7.5%)	70 (17.5%)	18 6 (46.5%)	104 (26.0%)	10 0%
15. Financial performance is reviewed regularly	8 (2.0%)	26 (6.5%)	66 (16.5%)	19 4 (48.5%)	106 (26.5%)	10 0%
Resource Management						
16. Resources are	10 (2.5%)	34 (8.5%)	72 (18.0%)	18 8 (47.0%)	96 (24.0%)	10 0%

allocated based on priorities						
17. Team workload is balanced and manageable	12 (3.0%)	36 (9.0%)	76 (19.0%)	18 2 (45.5%)	94 (23.5%)	10 0%
18. Adequate tools and technology are provided	8 (2.0%)	26 (6.5%)	80 (20.0%)	18 8 (47.0%)	98 (24.5%)	10 0%
19. Human resource skills match project needs	10 (2.5%)	30 (7.5%)	70 (17.5%)	18 6 (46.5%)	104 (26.0%)	10 0%
20. Materials are available when needed	14 (3.5%)	28 (7.0%)	74 (18.5%)	18 6 (46.5%)	98 (24.5%)	10 0%
Implement ation Efficiency						
21. Projects are completed on schedule	8 (2.0%)	22 (5.5%)	72 (18.0%)	18 8 (47.0%)	110 (27.5%)	10 0%
22. Projects are completed within budget	10 (2.5%)	24 (6.0%)	70 (17.5%)	18 8 (47.0%)	108 (27.0%)	10 0%

23. Quality standards are consistently achieved	6 (1.5%)	20 (5.0%)	66 (16.5%)	19 2 (48.0%)	116 (29.0%)	10 0%
24. Rework and errors are minimal	12 (3.0%)	28 (7.0%)	76 (19.0%)	18 6 (46.5%)	98 (24.5%)	10 0%
25. Coordination among departments is effective	10 (2.5%)	26 (6.5%)	70 (17.5%)	19 2 (48.0%)	102 (25.5%)	10 0%

The majority of the responses ended up being “Agree” and “Strongly Agree” which suggests a high level of satisfaction and the use of the “Project Design Management” practices.

The highest agreement rates for “Project Planning” and “Cost Management” dimensions suggest strong organizational control and structured execution.

Resource Management and Risk Management drew more neutral responses which indicates some unsatisfactory areas of Systematic Planning and Active Risk Management.

Overall, respondents view Project Design Management a central source for •
improving efficiency and productivity in oil and gas projects in Saudi Arabia.

1.32.1. Descriptive Analysis of Variables

Descriptive results show generally high mean scores (above 3.8 on a 5-point scale) across all dimensions, reflecting strong implementation of design management practices within the sector.

Variable	Mean	Std. Deviation	Interpretation

Project Planning	4.15	0.62	High
Risk Management	3.92	0.68	Moderate to High
Cost Management	4.10	0.64	High
Resource Management	3.85	0.70	Moderate
Implementation Efficiency	4.12	0.60	High

The respondents attributed highest scores to project planning and cost management, which points to a strong organizational emphasis on planning and control and financial planning and control. The slightly lower scores on resource management suggest struggles with the allocation of manpower or the flow of material, which is common in large, multi-site projects.

1.33. Reliability and Validity of Scales

All the constructions of the study were found to have a Cronbach's Alpha coefficient greater than the threshold of 0.70, thus confirming internal consistency as follows:

- Project Planning: $\alpha = 0.88$
- Risk Management: $\alpha = 0.86$
- Cost Management: $\alpha = 0.84$
- Resource Management: $\alpha = 0.82$
- Implementation Efficiency: $\alpha = 0.87$

The results of the study confirm that the questionnaire items were able to measure the intended dimensions of the study reliably.

1.34. Correlation Analysis

The results of the correlation showed that there were positive correlations between all the dimensions of PDM and implementation efficiency ($p < 0.01$).

- Project Planning ($r = 0.69$) – with the highest correlation, which means that well-defined design and scheduling enhances the chances of success when it comes to implementation.
- Cost Management ($r = 0.66$) – cost control is able to enhance the predictability of the performance outcomes.
- Risk Management ($r = 0.60$) – the less execution problems there are, the more proactive the risk assessment.
- Resource Management ($r = 0.55$) – project performance is more effective when human and material resources are utilized effectively. The overarching trend shows that an increase in the effectiveness of design management practices positively correlates to an increase in the efficiency of the project.

1.35. Regression analysis and hypothesis testing.

A multiple regression analysis was carried out to understand the impact formed by each dimension of PDM practices at the PDM framework level on the efficiency of implementation. The model offered by PDM practices significantly accounts and explains the implementation efficiency viz. 62% of the variation in implementation efficiency from the analysis performed ($p < 0.001$, $R^2 = 0.62$).

Predictor	β (Standardized Coefficient)	t-value	Sig. (p)	Interpretation

Project Planning	0.34	7.42	0.000	Strong positive impact
Risk Management	0.22	5.61	0.000	Significant positive impact
Cost Management	0.27	6.38	0.000	Significant positive impact
Resource Management	0.18	4.47	0.000	Moderate positive impact

Revising the hypotheses confirms all of them (H1–H4) as correct that the each dimension of PDM practices predicts efficiency in implementation of projects.

The data confirms the theory explained in Chapter 2. More specifically:

- H1 (Project Planning → Efficiency): Evidence says that uncertainty and better coordination increase with better planning.
- H2 (Risk Management → Efficiency): Stability in operations increases with the ability to identify and mitigate risks.
- H3 (Cost Management → Efficiency): Discipline in finance and timely correction results from the set budget and careful tracking.
- H4 (Resource Management → Efficiency): Better schedule adherence is achieved with proper allocation of resources.

Baqer et al. (2020), Al-Shehri & Al-Aqili (2024), and Ding et al. (2024) all support the data in saying that project performance is improved with integrated management of the design.

- Unlike the consultants, the owner and EPC contractor organizations reached higher efficiency scores which could be because of more control over design and resource decisions.

- Encouraging results were provided by professionals with more than 10 years of experience. This suggests that design discipline increases as the organization matures.
- Standardized project management systems such as PMBOK and ISO 21500 are adopted. This is evident from the minimal regional differences.

Summary of Chapter

In this chapter, we discussed the outcomes of the PDM's role in enhancing the efficiency of project implementation regarding the case study. Descriptive analysis indicated the planning and cost control practices have been strongly adopted. Reliability and correlation analyses affirmed strong PDM relationships with efficiency outcomes. Regression analysis indicated that project planning, cost management, and risk management exerts the most substantial effect and together, account for over 60% of the variation in efficiency.

These findings establish solid empirical groundwork for the narrative in Chapter 5, where discussion of theoretical integration, practical implications, and recommendations will be provided.

CHAPTER 5: DISCUSSION

Introduction

In this chapter, I will interpret the results from the previous chapter. I will also incorporate the results from the previous chapter to frame them around the existing theories and empirical work. I will bridge the results on the dimensions of Project Design Management (PDM)—Project Planning, Risk Management, Cost Management and Resource Management and their association with Implementation Efficiency. I will then show how these associations demonstrate both global best practices and the realities of the Saudi oil and gas sector.

Like the previous chapter, this chapter also relates these results to the Saudi Vision 2030 which aims to achieve operational excellence, sustainability, and efficiency in all the industries.

1.36. Overview of Findings

Form the analysis of 400 respondents, I found out that a majority of the respondents agreed or strongly agreed on the statements that described the processes of design and management in projects. This indicates a high level of maturity and awareness of project professionals in the oil and gas sector in Saudi Arabia.

Project Management, among the four dimensions of Project Design Management, Project Planning had the strongest positive correlation with implementation efficiency followed by Cost Management, Risk Management, and Resource Management. This is in line with other studies done abroad that emphasize the importance of structured planning in achieving cost control and the positive enhancement of project performance.

1.37. Discussion

1.37.1. Project Planning and Implementation Efficiency

The results indicate there is considerable and positive correlation between Project Planning and Implementation Efficiency. Respondents agreed that having clear project objectives alongside clear boundaries and schedules was beneficial for completing projects within budget and on time.

This is consistent with PMBOK (Project Management Institute, 2021), which suggests planning is a prerequisite of the success of any project. Equally, Kerzner (2019) noted the importance of planning in his works and argued that it reduces ambiguity while ensuring that the necessary resources are aligned with the project objectives.

In the setting of the Saudi oil and gas industry, robust project planning is essential for the intricate, multidisciplinary, and sophisticated engineering nature of the industry. The results also confirm the works of Alzahrani and Emsley (2018) who argued that proper planning of a project leads to better results in the execution of large-scale infrastructure projects in Saudi Arabia.

This shows that there is a positive correlation between the level of project planning and the lengths of implementation in a project design integration which leads to favorable results in frame planning, timing, and stakeholder participation.

1.37.2. Risk Management and Implementation Efficiency

The correlation between Risk Management and Implementation Efficiency was found to be positive, however, slightly weaker. This indicates that in oil and gas projects in Saudi Arabia, the identification and mitigative practices of risks exist, but are yet to be deeply integrated within the system.

Most respondents highlighted the need to keep risk registers updated, track potential problems, and capture lessons learned, though some respondents gave neutral answers, suggesting differences between organizations.

This is consistent with Hillson (2017) and Rahman & Alhassan (2020), who note that the practices of risk management in most industrial projects are more reactive than proactive.

Still, the strength of this association suggests that having risk management integrated in the design phase minimizes the amount of rework required to be done, the number of safety incidents, and improves the reliability of project scheduling.

In the context of industrial transformation under Vision 2030, the risk management is becoming more and more embedded – particularly in energy megaprojects – through the application of ISO 31000:2018 and the Project Risk Management Framework by ARAMCO (2023).

1.37.3. Management of Costs and Efficiency of Implementation

Respondents indicated that Cost Management had a strong and significant effect on the efficient implementation of the projects. In their opinion, project success stems from proper budgeting, consistent monitoring of expenditures, and analyzing budget variances.

This is consistent with Flyvbjerg et al. (2018), who showed that the implementation of cost control systems enhances efficiency in the delivery of megaprojects. El-Sayegh et al. (2020) also found that projects with strong financial supervision exhibit increased productivity and lower cost overruns.

With regards to Saudi Arabia, the oil and gas projects are very expensive and value consciousness is an important criterion. Therefore, the findings imply that the systems and processes that digitize the costs, and the periodic financial assessment works greatly to enhance implementation efficiency. This supports the aims of Saudi Arabia's Vision 2030, which aims to enhance infrastructure ROI through improved financial oversight and accountability. Saudi Arabia's Vision 2030 aims to ROI from infrastructure increased through improved oversight in financial governance and accountability. This aims.

1.37.4. Streamlining and Improvement of Resources Management

Results show that the relationship that sits within the Resource Management and Implementation Efficiency is positive, although moderate in strength, this is complicated by the relatively neutral response from some which contrasts the prevailing agreement that, appropriate systems are put in place, workload balance and material timings are managed, supported with proper materials and tools are made. Project and departmental practices are inconsistently managed, as measured in the above response.

This is the same as Turner's (2018) belief that whether a project is perceived to be successful or a failure is largely dependent on how resources have been used, especially in an environment where resources are limited.

Ofori (2019) however, pointed out that, even in an era with sophisticated system, the alignment of people and materials in construction processes in large projects is still a problematic area due to the ill-patterned control on supply and workforce control.

Forward looking to the future of supply chain systems in Saudi Arabia, the ongoing projects that aim to hire local people (Saudization) and advanced digital systems in the supply chain are to enhance resource control.

1.37.5. Implementation Efficiency

The Implementation Efficiency in the current study pertains to the performance indicators of on-time completion, budget adherence, cost, and coordination. The level of agreement indicates that the respondents believe that the oil and gas projects in the Saudi Arabia region are achieving the desired performance targets.

This supports the argument of Atkinson (1999), which suggests that the success of a project should be assessed through its 'Iron Triangle' of time, cost, and quality.

These also suggest that the PDN dimensions have cumulative effects: effective advanced planning diminishes rework, vigilant cost oversight ensures that the project stays within budget, and effective risk and resource management keeps the project on track.

This is consistent with the findings of Love et al. (2020), who assessed that integrated design management systems streamline communication, reduce design time, and improve project performance.

1.38. Integration with Theoretical Framework

The results of the study support the theory discussed in Theoretical Framework in Chapter 2 on Systems Theory and the Resource-Based View (RBV) and what was presented.

In Systems Theory, a project is seen as a set of interlinked and interdependent phases which include planning, risk management, costing, and resource allocation and that all need to be integrated for better efficiency. The strong positive relationships between the dimensions of these factors indicate that integration on a system level is needed for improvement in performance.

According to the Resource-Based View (RBV), the internal organization capabilities such as human resource professionalism, sophisticated planning, and hi-tech machinery are the key elements for the competitive advantage firms want to sustain. The results support that the Saudi oil and gas sector gains from the strengthening of such internal capabilities via structured PDM systems.

1.39. Comparison with Previous Empirical Studies

The results obtained are consistent with findings from other countries.

Doloi (2017) and Kerzner (2019) proved that the coordination of design and stakeholders improves the efficiency of a project.

Flyvbjerg (2020) points out that planning and risk control are the major determinants of success for a megaproject.

Alzahrani and Emsley (2018) have identified similar patterns with the construction projects in Saudi Arabia, which adds to the external validation of this research.

These findings, which together reinforce the PDM principles and their applicability to the oil and gas sector, further support the perceived broad reach of the principles.

1.40. Implications of Findings

The research clearly indicates that integration of Project Design Management frameworks improves the decision-making quality, communication, and stage integration of the projects.

This means, on the practical side, that Saudi oil and gas companies should assimilate design management systems as part of the organization's structure at the nexus of the engineering, finance, and operations functions for easy vertical and horizontal integration supported by digital platforms.

On the other hand, the findings also enrich the project management body of knowledge by serving as a foothold for research on the Middle Eastern region that has not been included in many global studies.

1.41. Summary of the Discussion

In general, the research validates that the implementation of Project Design Management aids in the enhancement of project efficiency in the oil and gas sector of the Kingdom of Saudi Arabia.

In this case, Project Planning and Cost Management are the first, and most significant, followed by Risk and Resource Management in that order.

These results still affirm the theoretical model highlighted in Chapter 2 of this work and are consistent with the rest of the world in focusing on integrated and structured design processes as determinants of project success.

These results also support the integration of PDM practices with the 2030 Vision goals, particularly through the digital economy, local capacity building, governance, and PDM practices, which underpin efficiency and sustainability in Saudi engineering projects.

CHAPTER 6: SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Introduction

In this last chapter, we summarize the whole study and synthesize what the study has captured in the earlier chapters. Then we draw the conclusions and recommendations to provide based on the outcomes. The purpose is to assist in understanding how Project Design Management (PDM) improves efficiency in engineering project execution in the Saudi oil and gas industry. It also deals with the theoretical, management, and policy contributions along with suggestions for further research.

1.42. Summary of the Study

1.42.1. Purpose and Objectives of the Research

This study sought to investigate the relation between the practice of Project Design Management (PDM) and the efficiency in the implementation of engineering projects. The objectives were to:

Assess the extent to which PDM is practiced in the Saudi oil and gas industry.

Determine the influence each dimension of PDM has (planning, managing, and controlling risks, costs, and resources) on the efficiency of project implementation.

Analyze the PDM's performance as a unified system in relation to the integrated time, cost, and quality parameters.

Formulate recommendations to improve the effectiveness of design management systems in Saudi Arabia.

1.42.2. Research Design and Methodology

This study utilizes a quantitative descriptive-analytical research methodology. Data was collected using a structured questionnaire with a five-point Likert scale that was used to question 400 professionals within the oil and gas sector, such as project managers and engineers, as well as planners. The study posits independent variables along five dimensions:

- Planning
- Managing Risks
- Managing Costs
- Managing Resources
- Implementing the Plan

Hypotheses were tested and variables relationships assessed using statistical methods of descriptive correlation and multiple regression.

1.42.3. Key Results Summary

This study established that all dimensions of project development management positively enhance performance PDM as practiced within organizational frameworks.

Planning was the most significant PDM dimension, followed by Cost Management, Risk Management, and Resource Management, respectively.

The model predicted 62% of the variance in Implementation Efficiency further indicating high confidence in PDM as a predictor.

The study participants demonstrated high agreement with practices aligned to PDM frameworks indicating a high level of organizational PDM.

The results confirm that effective design management systems improve project delivery performance, and as such, supports the objectives of Saudi Vision 2030 by enhancing the efficiency, transparency, and sustainability of industrial operations.

1.43. Conclusions

The fundamental conclusion is that Project Design Management is pivotal in achieving the efficiencies available within the Saudi oil and gas industry. The seamless integration of planning and scheduling, cost control, risk management, and resource management dramatically improves projects in terms of on-time performance, budget control, quality, and stakeholder satisfaction.

1.43.1. Theoretical Conclusions

The results support important management theories, particularly Systems Theory, which deals with the interdependence of subsystems within projects and the Resource Based View (RBV) which argues that internal resources and capabilities are the sources of sustained competitive advantage.

The results of the study support the view that project design is more than technical, and a project of management that determines the level of efficiency and competitiveness of the organization.

This work contributes to the literature in the form of a model by demonstrating how the PDM practices in the framework of design management are PDM practices in the framework of design management are PDM practices in the framework of high-risk industrial environments.

1.43.2. Empirical Conclusions

Projects that apply design and management within a structured PDM framework are less likely to experience timeline slippage, cost overruns, and exceed quality thresholds.

The positive correlations among all dimensions of PDM reinforce the argument that PDM practices are more effective when used in an integrated approach rather than a modular approach.

Through feedback and comments, it was evident that culture within the organization, effective communication, and leadership commitment are important factors in the successful design management.

1.43.3. Managerial and Policy Implications

– For Project Managers

Establish planning processes that are more thorough and include risk mitigation strategies and planning, deliverables, risk registers, milestones designs, and timelines.

Boost communication among cross-functional groups to ensure the original design and the construction processes are properly synchronized, no matter how thick the walls are.

Implement Project Management Information Systems for the management and control of designs and costs, i.e. BIM, Primavera, and MS Project.

– For Organizations and Corporations

Implement the frameworks for Project Design Management systematically across all functions and systems.

Integrate training in advanced planning, risk, and cost control management with in-house and external professional certification to develop advanced organizational designs.

Foster a cultural attitude and systematic practice of capturing, sharing, and improving the use of lessons learned and knowledge across different projects.

Develop Strategic Performance Management Systems to measure Project Design Management, and assess the design approval period, the number of change orders, and risk control objectives to evaluate the risk mitigation frameworks.

1.43.4. For Policymakers

Stimulate the application of unified reference documents for the integrated design management of large infrastructure and energy works at the national level.

Under the Vision 2030 Framework, foster the localization of project management standards as a means of enhancing self-reliance and diminishing the over-reliance on foreign project management consultants.

Further develop collaboration between the academic and engineering faculties and the industry to ensure that basic engineering practice competencies in project management are integrated into the curriculum.

1.44. Contributions to the Study

1.44.1. Theoretical Contributions

The study adds to the existing literature by establishing for the first time the relationship between the dimensions of PDM with project efficiency in the Saudi Arabia. This area has been lacking scholarly work.

It synthesizes the diverse theoretical frameworks (Systems Theory, Lean Management, RBV) to construct a singular conceptual framework relevant in the context of mega engineering projects.

1.44.2. Practical Contributions

Documents a refined design management framework that organizations can utilize for assessment and relative design management performance.

Provides actionable recommendations for Saudi Arabia's oil and gas industry aimed at improving competitiveness, minimizing wastage, and operational excellence.

This helps to guide project management office (PMO) practices to align with the framework of Saudi Vision 2030.

1.45. Limitations of the Study

The study findings are inevitably based on self-reported survey data, thus, the performance measures are likely to be biased and subjective in nature.

As the study is cross-sectional in nature, it is not possible to ascertain the causal relationships between the studied variables.

The analysis was only conducted for the oil and gas sector in Saudi Arabia, thus, the findings may be applicable to other sectors and countries.

The analysis was limited to four dimensions of PDM and excluded other factors which are the emerging importance of digital transformation, sustainability and practices, and innovative PDM which would have greatly enhanced the analysis.

1.46. Future Research Suggestions

Carry out longitudinal research to establish changes in PDM practices over different phases of a project's lifecycle.

Use qualitative approaches such as interviews and case studies to better understand managerial actions.

Analyze how digital project design tools such as BIM, AI, and simulation modeling improve design coordination and efficiency.

Apply the model to other industries such as renewable energy, construction and petrochemical.

Analyze the impact of moderating variables such as leadership style, organizational culture, and innovation capability on the effectiveness of PDM.

1.47. Conclusions

The research conducted shows that the design management for the projects on the oil and gas industry is crucial in achieving successful project completion. Engineering process efficiency and integration is crucial for the rapid industrial growth and diversification of Saudi Arabia during the 2030 vision.

Higher organizational performance, improved safety, and enhanced sustainability are possible by implementing thorough frameworks for managing Project Design. These

frameworks are structured on well-defined planning, proactive risk management, disciplined cost control, and optimal resource deployment.

This research adds to the existing body of knowledge and practice by refining the approach of project leaders in Saudi Arabia. This helps them improve their approach towards innovative, efficient and globally competitive project management.

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Appendix

Section A: Demographic Information

Variable	Category
Gender	☐ Male ☐ Female
Age	☐ 20–29 ☐ 30–39 ☐ 40–49 ☐ 50 and above
Education Level	☐ Diploma ☐ Bachelor ☐ Master ☐ Ph.D.
Job Role	☐ Project Manager ☐ Engineer ☐ Planner ☐ Cost Controller ☐ HSE ☐ Supervisor ☐ Other
Years of Experience	☐ <3 ☐ 3–5 ☐ 6–10 ☐ >10 years
Organization Type	☐ Owner ☐ Contractor ☐ Consultant ☐ Service Provider
Project Type	☐ Upstream ☐ Downstream ☐ Refinery ☐ Other
Region of Work	☐ Central ☐ Eastern ☐ Western ☐ Southern ☐ Northern

Part 1 – Project Planning (PLN)

Statement	1	2	3	4	5
Project objectives and deliverables are clearly defined before implementation begins.	☐	☐	☐	☐	☐

Work Breakdown Structure (WBS) and schedules are well prepared and communicated to all stakeholders.	☐	☐	☐	☐	☐
Stakeholder requirements are thoroughly reviewed during the design phase.	☐	☐	☐	☐	☐
The project planning team ensures adequate coordination among disciplines.	☐	☐	☐	☐	☐
Changes to project scope are managed through formal approval processes.	☐	☐	☐	☐	☐

Part 2 – Risk Management (RISK)

Statement	1	2	3	4	5
Potential project risks are identified early in the design phase.	☐	☐	☐	☐	☐
A formal risk register is maintained and regularly updated.	☐	☐	☐	☐	☐
Mitigation actions are implemented promptly when risks are detected.	☐	☐	☐	☐	☐
Lessons learned from previous projects are integrated into new designs.	☐	☐	☐	☐	☐

Contingency plans are developed for major risks identified.	☐	☐	☐	☐	☐
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Part 3 – Cost Management

Statement	1	2	3	4	5
Project budgets are accurately estimated during the design stage.	☐	☐	☐	☐	☐
Cost tracking and variance reports are produced regularly.	☐	☐	☐	☐	☐
Any deviations from the budget are promptly analyzed and addressed.	☐	☐	☐	☐	☐
Cost optimization is considered in design decisions.	☐	☐	☐	☐	☐
The organization applies cost control software or digital systems for budget monitoring.	☐	☐	☐	☐	☐

Part 4 – Resource Management

Statement	1	2	3	4	5
Human resources are allocated according to project priorities.	☐	☐	☐	☐	☐

The organization ensures the availability of materials on schedule.	☐	☐	☐	☐	☐
Equipment and technology are used efficiently during implementation.	☐	☐	☐	☐	☐
Project teams receive adequate training for their assigned tasks.	☐	☐	☐	☐	☐
Resource utilization is regularly monitored and adjusted as necessary.	☐	☐	☐	☐	☐

Part 5 – Implementation Efficiency (EFF)

Statement	1	2	3	4	5
Projects are completed on schedule without major delays.	☐	☐	☐	☐	☐
Projects are executed within the approved budget.	☐	☐	☐	☐	☐
Project outputs meet specified quality and safety standards.	☐	☐	☐	☐	☐
There is effective coordination among design,	☐	☐	☐	☐	☐

procurement, and construction teams.					
Minimal rework or design errors occur during project execution.	☐	☐	☐	☐	☐

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النفط والغاز: دراسة تطبيقية في السعودية

إعداد الطالب/

علي ال علوي

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د. الفیصل عبد الحمید محمد حسن

العام الدراسي:

2025