

Final Project 2

PMG 497

Project Report

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The Impact of Optimization on Reducing Construction Costs in the Oil and Gas Sector in Dhahran, Saudi Arabia: A Case Study of Saudi Aramco's Projects

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Dedication

I dedicate this research to my late father, my mother, my family, and my true friends.

Abstract

Purpose:

Completion of well technology is one of the most important steps in oil and gas well production. Saudi Aramco has given significant attention to this field development scheme (Radhwi et al., 2013).

Initially, directional drilling tools are used to drill the well and build the necessary curve to land on the right reservoir, where oil or gas is the main production component. During this process, while running the completion assembly, an additional step is taken to check that the tubular is free of damage to avoid any issues, which could fail the whole project and result in paying additional tangible and intangible costs, which could be avoided.

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1. Chapter 1: Introduction

1.1. Research Background

Generally, well construction involves a series of operations that are directed by the lease operator, who employs the drilling contractor and third-party equipment and personnel (Saleh et al., 2014). The process of estimating and analyzing the overall cost of drilling presents new challenges and responsibilities for industry professionals. Furthermore, achieving cost-effective drilling is a key objective for the industry as it is essential for successful and sustainable drilling. By definition, sustainability includes cost as a critical factor (Agbon, 2002).

The oil industry has significantly increased worldwide drilling activities in response to the growing global demand for hydrocarbon. However, the addition of new and advanced equipment, tools, and technologies in drilling a well has led to higher costs. On the other hand, these facilities have reduced drilling time, which has contributed to lower drilling costs. Consequently, the drilling industry is faced with a cost analysis dilemma (Aggarwal & Kaldi, 2018).

Cost-effective drilling is a significant concern for the drilling industry to achieve success and sustainability (Al-Bani et al., 2007). Sustainability encompasses cost as one of its parameters. However, the current energy management sector is facing significant challenges due to the lack of proper training in managing financial sustainability. This has led to immense frustration in the industry (Oag. & Williams, 2000).

The energy management sector is facing a major problem due to the lack of appropriate training in handling financial sustainability. Despite numerous solutions being proposed, it is becoming increasingly evident that these options are not leading to a sustainable state in our drilling environment. This has caused significant frustration among stakeholders (Hossain & Al-Majed, 2015, pp. 227-247).

The main challenge was to implement the preferred optimization solution without a global track record. Additionally, we needed a full agreement from Aramco to trial test our new solution on their active projects, without incurring any additional costs or failures during the trial phase (Ikediashi et al., 2014).

This research aims to analyze the impact of optimization on reducing the cost of constructing wells in the oil and gas industry. It will provide a real-life example of full implementation in wells completed for Saudi Aramco, both onshore and offshore fields (Shammas, 2000).

1.2. Research Problem

While constructing the well, not doing the job right the first time can increase costs, which might end up suspending the whole project as it exceeds the original planned and estimated project costs and timeline (Seddeeq et al., 2019).

The research problem will address theoretical and empirical gaps.

1.2.1. Theoretical Gaps

The lack of understanding of the importance of fully applying optimization in drilling and completion projects on both types of projects for oil and gas resulted in blindly repeating the same process and making the same mistakes while not considering any other solution that could reduce the risk and faults of resolving the main issue, which is the integrity of the casing or tubular, while doing conventional drift operations (Abdullah et al., 2011).

1.2.2. Practical Gaps

The shortage of research shows the time and cost savings of applying new techniques to consider and recognize operational problems without waiting to run the checkout equipment at the end of the job, which can result in double the cost of the whole project once repeated due to the late discovery of problems in casing or tubulars, and which can affect the next phase of drilling or completion for the same project.

1.3. Research Significance

The importance of the theoretical and empirical aspects of this research is to close the gaps as well as improve the use of optimization in drilling and completion projects in both the oil and gas industries (Solares, 2001).

This search aims to conclude the following:

Optimization can improve budget utilization and planning for oil & gas projects, and by adopting a cost-conscious approach, further savings can be achieved in these projects.

1.3.1. At the theoretical level

This research will result in the development of a new operational plan and procedure that will help to improve the total process of doing the planned jobs and applications for Saudi Aramco by helping to identify any bad joints in either casing or tubulars before it is too late by applying an immediate inspection to all the joints without interrupting the normal operations of running in holes.

1.3.2. At the practical level

By applying a single example of optimization, the drilling and completion operations can run smoothly while meeting both the cost and timelines of the oil and gas drilling program, which results in significant time and cost savings by discovering any problems ahead of time and with no additional risk at all. Additionally, to complete all the needed and planned steps in a total health- and safety-risk-free working environment.

1.4. Research Questions

Based on all the above, this research will answer the below question:

“How can we reduce the cost of well construction for both oil and gas projects by implementing an optimization technique that can discover any problem at the early stage while ensuring successful operation without additional risk or cost beyond budget?”

1.4.1. Research Sub-Questions

- What impact does optimization have on the economy of oil and gas operations?
- How does empowerment affect budgets and the economy when optimizations are applied?
- What is the effect of adopting a cost-conscious approach for the entire process of oil and gas operations while applying optimizations?

1.5. Research Objectives

The general objective is to explore the relationship between cost reduction and optimization techniques in the oil and gas projects in Saudi Aramco.

The sub objectives will be:

- Identifying the effect of optimization in the oil and gas industry.
- Identifying the effect of optimization on the budget and economy of the oil and gas projects.
- Identifying the effect of applying optimization techniques on the cost-consciousness of oil and gas projects.

1.6. Research Hypotheses

1.6.1. Main Research Hypotheses H1

There is a significant correlation between optimizing the process of constructing oil and gas projects and reducing their costs.

1.6.2. The First Research Sub-Hypothesis Ha

There is a significant correlation between optimization and budget savings in oil and gas investment projects.

1.6.3. The Second Research Sub-Hypothesis Ha

There is a statistically significant relationship between optimization in the process of oil and gas projects and cost-consciousness.

1.6.4. The Third Research Sub-Hypothesis Ha

There is a significant relationship between optimizing the techniques of oil and gas projects and reducing their costs.

1.7. Research Model

The following figure shows the relationship between the research variables and the research hypotheses as follows:

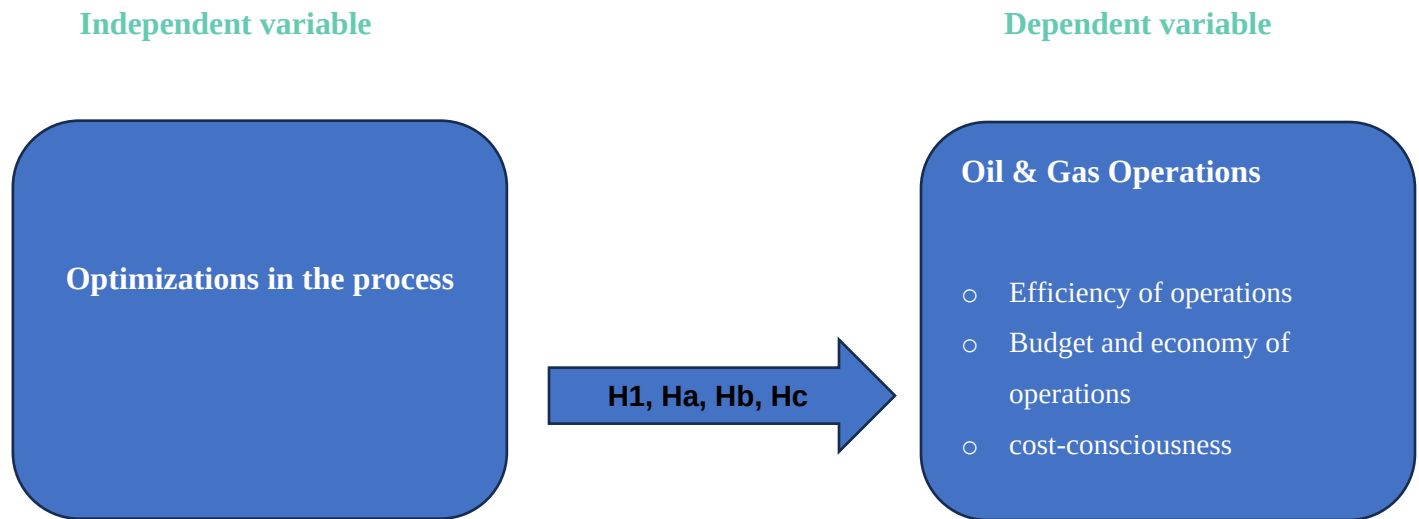


Figure 1: Proposed Research Model (The Researcher, 2024)

1.8. Scope of The Study

This research will be conducted in Dhahran, which is a city situated in the Eastern Province of Saudi Arabia. It serves as a significant administrative hub for the country's oil industry. For the past 90 years, Dhahran has been the headquarters of Saudi Aramco and is also the largest gated compound owned by the company (Khorsheed, 2015).

1.9. The Project Structure

Suggested Research Structure		
	Chapter 1: Introduction	
	Chapter 2: Literature Review	
	Chapter 3: Research Methodology	
	Chapter 4: Statistical Analysis	
	Chapter 5: Findings, Discussion and Conclusion	

Table 1: Suggested Research Structure (The Researcher, 2024)

2.Chapter 2: Literature Review

2.1. Introduction

In this chapter, I will discuss the independent variable and the three dependent variables based on my research. I focused on the optimization process in the oil and gas sector, specifically for the operations of Saudi Aramco in Dhahran. The three main variables that I covered in my research are efficiency in operations, budget and economy of operations, and cost-consciousness. These variables will be explained as we go through this chapter and during my analysis.

2.2. The Independent Variable

2.2.1. Literature Review- Independent Variable: Optimization Process

2.2.1.1. Introduction

The exploration and production (E&P) activities in the oil and gas industry are becoming more expensive, risky, and technology dependent as operations move from easy to challenging frontiers. To manage these risks and share operational costs, even major and super major oil companies are forming joint ventures and consortia to explore new frontiers. Given the inherent risks and uncertainties in the upstream business, it is crucial for oil companies to use their capital and resources wisely. Optimizing strategies, resources, and costs while improving business performance across all E&P activities is essential for survival and ensuring the sustainability of the business. The guiding principle is "money saved is money earned." Achieving these goals requires innovative ideas, a change in mindset, a fresh perspective, and new approaches to doing business.

2.2.1.2. Definition

Optimization, in its simplest form, refers to achieving the best available value or most favorable result under a given set of conditions or constraints. It commonly involves the maximization or minimization of an objective function while adhering to a set of constraints. Optimization is primarily a mathematical technique that finds wide application in engineering, management

science, economics, mathematics, and various other fields. The literature contains numerous definitions of optimization, ranging from simple to complex.

2.2.1.3. Development

Optimization models and techniques are classified based on the types of objective function and set of constraints. These classifications include linear programming, integer programming, geometric programming, goal programming, quadratic programming, nonlinear programming, fractional programming, dynamic programming, and so on. These techniques are essentially extensions of linear programming or particular cases of nonlinear programming.

2.2.1.4. Explanations

Multiple cutting-edge optimization and business enhancement techniques have been successfully applied to elevate productivity in drilling operations, minimize rig time loss, and strategically optimize deepwater oil and gas exploration. These techniques include benchmarking, diagnostic and root cause analysis, as well as technical, qualitative, and economic assessments. The implementation of queuing theory, critical path analysis, and uniform standards based on international codes has further streamlined operations, ensuring efficiency across supply chain management and workforce planning. Additionally, consumption standardization and linear programming have contributed to significant improvements, making our processes more robust and cost-effective.

2.3. The Dependent Variables

2.3.1. Literature Review-First Variable: Efficiency of Operations

2.3.1.1. Introduction

Why is operational efficiency important?

A business's operations encompass all the activities it undertakes to create products or services. Inefficient operations can lead to wastage of money and effort (Mohamed Khodja et al., 2010, pp. 227-247). On the other hand, efficient operations are cost-effective as they reduce waste while maintaining quality and service standards.

2.3.1.2. Definition

Operational efficiency can be defined as the relationship between the output and input of an organization is vital for businesses to thrive. When it is healthy, it can help them to reduce unnecessary costs while increasing revenue. Essentially, businesses aim to produce high-quality products on a large scale with minimal resources.

2.3.1.3. Development

Generally Streamlining base operations, eliminating redundancy and waste, and optimizing resource utilization, production, inventory, and distribution, can improve a company's operational efficiency (Khodja & Bergaya, 2010).

2.3.1.4. Theories

Research presents two theories: the Theory of Swift, Even Flow, and the Theory of Performance Frontiers. These theories address cross-operational productivity differences and multiple dimensions of oil and gas performance, respectively.

2.3.1.5. Dimensions

Operational efficiency is the measure of how well an oil and gas company manages its internal processes to improve the performance of its oil and gas customers. It is evaluated based on the business's flexibility, consistency, productivity, and cycle time. Flexibility refers to a company's ability to adapt to changing business conditions and meet customers' immediate and long-term needs (Muñoz et al., 2016).

2.3.1.6. Explanations

The People, Process, and Technology (PPT) framework is a comprehensive approach that companies can use to create a balanced and coordinated system that effectively supports their business operations and change management initiatives. The framework emphasizes the importance of ensuring that people, processes, and technology work together in harmony to achieve successful outcomes. If one of these elements is weak or not aligned with the others, it can negatively impact the overall effectiveness and efficiency of the business. The objective is to create synergy among all three components, leading to improved business outcomes.

Although the PPT framework is typically applied to project management and change management initiatives, it can be used to assess and optimize all aspects of a company's operations, including setting targets, managing risks, and pivoting strategies.



Figure 2: Three Pillars for c (Mustafa et al., 2021)

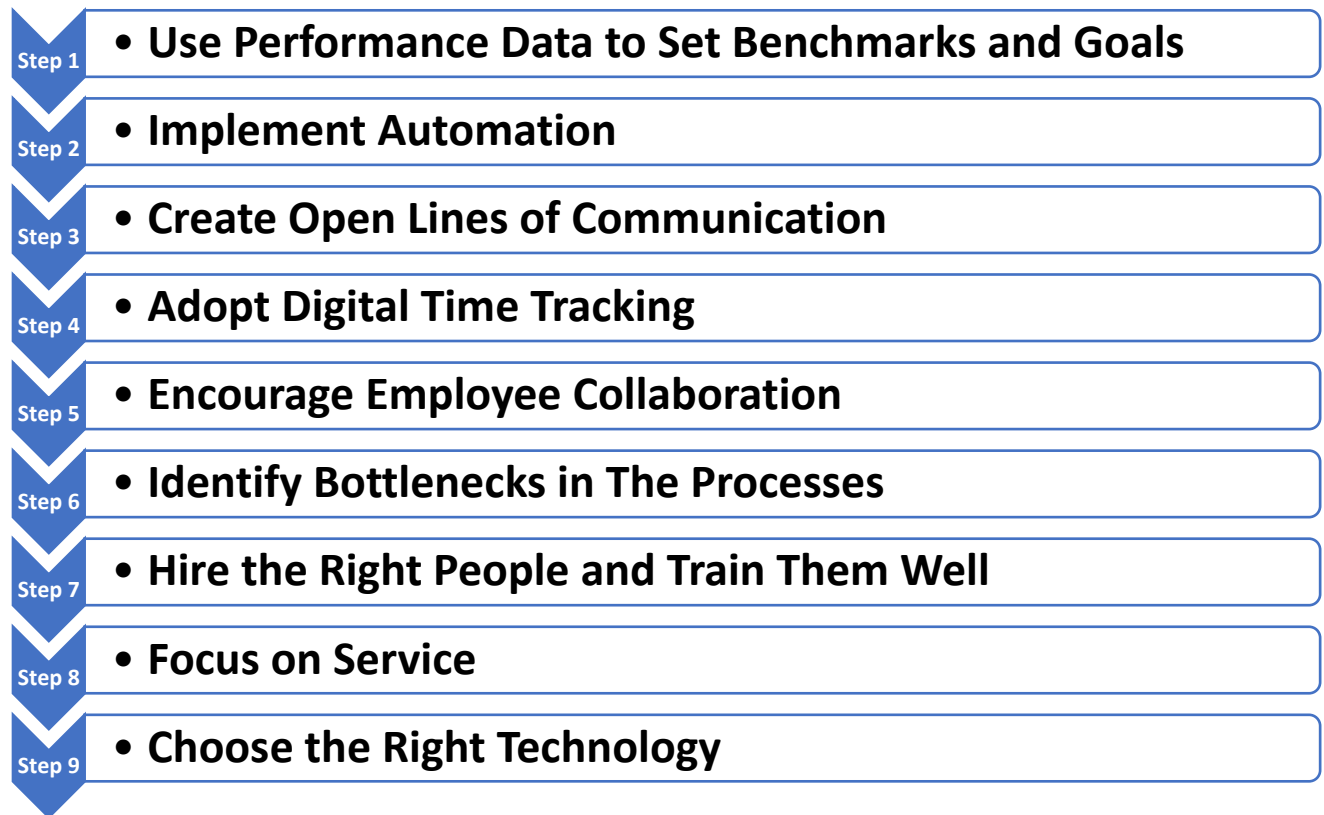


Table 2: 9-Steps to Improve Operational Efficiency (Brett & Millheim, 1986)

- Use Performance Data to Set Benchmarks and Goals:

One effective way to engage your staff in enhancing your business's efficiency is by setting SMART goals that are specific, measurable, achievable, relevant, and time bound. Moreover, it's important to establish methods of celebrating when those goals are either met or exceeded.

- Implement Automation:

Automating repetitive tasks maximizes staff efficiency and allows the project team to focus on critical duties.

By implementing suitable automation tools, the project manager can enhance the value of the time spent by his team. This is because the team can focus on responsibilities that truly require their skills and expertise. Automating repetitive

tasks will also help to keep the project team more engaged by freeing up their schedules from mundane tasks.

- Create Open Lines of Communication:

One way to show the project team that the project manager values and appreciates them is by implementing automation. However, providing additional support efforts can go a long way in improving the company culture, enhancing staff performance, and keeping your team motivated and invested in the business. Effective communication is also essential to ensure that team members are not overwhelmed with tasks that they are unable to handle or complete on time.

- Adopt Digital Time Tracking

Digital time tracking enables project managers to analyze their staff's time usage thoroughly, identifying tasks where employees spend excessive time.

- Encourage Employee Collaboration

Encouraging project team members to communicate and collaborate with one another can lay the foundation for discussing process improvements that lead to more efficient business operations. Working together, employees can find innovative solutions to challenges. You might be surprised by the ideas and innovative thinking that result from such collaboration.

To foster collaboration, project and staff management teams can implement regular meetings or calls, use team-building strategies, and focus on developing a company culture that promotes a collaborative work environment.

- Identify Bottlenecks in The Processes

As the project manager focuses on enhancing the efficiency of the business, it's essential to evaluate how the business operates as a whole. There may likely be bottlenecks in multiple processes, which may hinder your productivity. Identifying

bottlenecks can be challenging, especially if the project manager is not familiar with the processes. In such cases, it's advisable to communicate with the team and request them to identify areas that need improvement. Afterward, work with the team to come up with the necessary resources to improve the processes.

- Hire the Right People and Train Them Well

Improving operational efficiency can help maximize productivity, especially when working with a limited staff. However, it's crucial to ensure that the project manager has the right team members with the necessary skills. Employees who lack the required skill sets for their respective roles can slow down the team's progress and drain resources. By adding a key staff member, you can often increase a project's productivity, giving the existing team the additional support needed to succeed.

- Focus on Service

The project service team can boost sales, upsell products and services, and retain clients, provided they possess the necessary knowledge, skills, and tools.

- Choose the Right Technology:

Choosing the right technology is arguably the most important decision.

2.3.2. Literature Review-Second Variable: Budget and Economy of Operations

2.3.2.1. Introduction

The Oil and Gas Project Budget is a crucial tool used by project managers to determine the total cost of a project. A project budget template includes a detailed estimate of all costs that are likely to be incurred before the project is completed. Large commercial projects can have project budgets that are several pages long.

2.3.2.2. Definition

An operating budget is a detailed projection of an oil and gas company's expected revenue and expenses over a specific time period, often a year or the project life cycle.

2.3.2.3. Development

The operating budget for oil and gas is created and approved yearly, or prior to commencing any project. This budget is then compared to actual results throughout the year or the lifespan of the project to assess progress toward the organization's financial goals. The budget should include expected revenues and various types of expenses, which may incorporate fixed, variable, and one-time costs.

2.3.2.4. Theories

There are two methods to calculate the operational budget for oil and gas projects (Bianca Sarbu, 2011), which are:

- a. $\text{Operating Costs} = \text{Direct Production Costs} + \text{Fixed Charges} + \text{Asset Overhead Costs}.$
- b. $\text{Total Opex (or Total Production Cost)} = \text{Operating Costs} + \text{General Expenses}.$

2.3.2.5. Dimensions

The operating budget primarily consists of sales budget, production budget, and cash budget (both cash receipt and cash payment budget). Of the components of the operating budget.

2.3.2.6. Explanations

CCH Tagetik empowers the oil and gas industry to comprehend the effects of market fluctuations, capital investments, and labor costs while forecasting profitability, regardless of the emerging scenario.

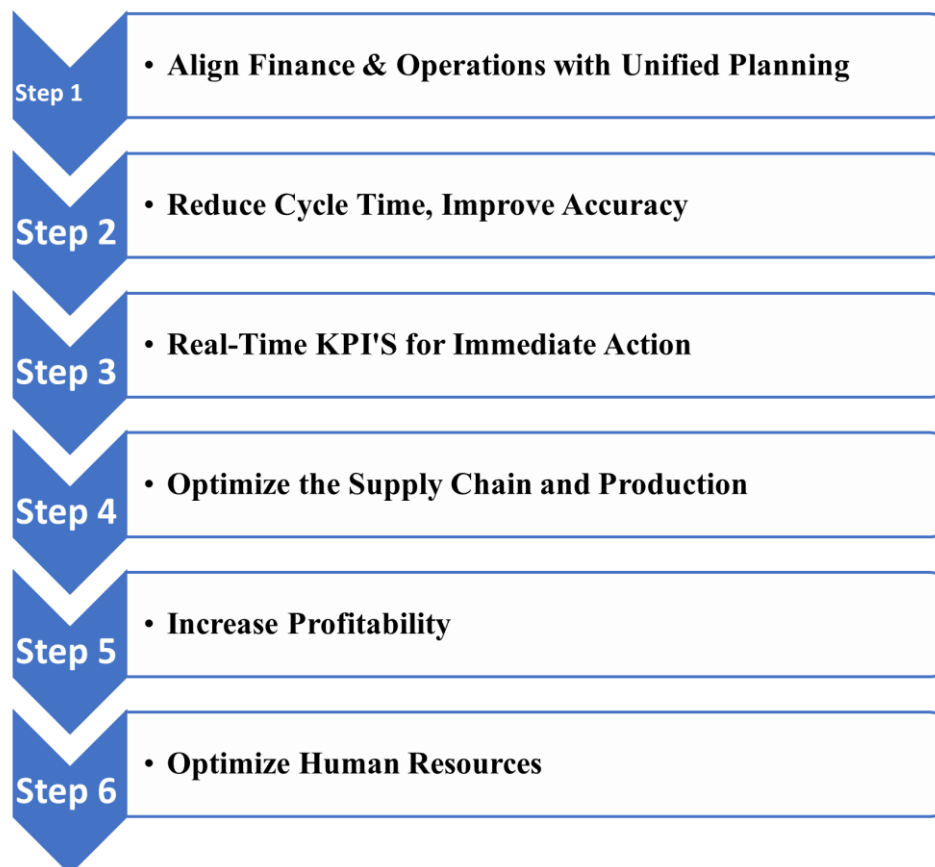


Table 3: CCH Tagetik Planning for Oil and Gas Projects (Alnhash et al., 2020)



Figure 3: Key Benefits of Economic Budgeting in Projects (Ahmed et al., 2007)

The primary benefits of implementing economic budgeting in projects can be summarized into key points.

- Reduce Planning Cycle Time
- Optimize Resources
- Align Finance & Operations
- Increase Accuracy, Efficiency & Control
- Reduce Risk
- Lower Total Cost of Ownership (TCO)
- Modernize Finance Technology

In addition to forecasting, which represents an undeniable advantage of the budget, using budgeting in enterprise management has many benefits, including communication, coordination, authority, responsibility, mobilization, motivation, and support in decision-making.

2.3.3. Literature Review-Third Variable: Cost-Consciousness

2.3.3.1. Introduction

The awareness and attitude of project team members towards efficient resource use, waste minimization, and expense reduction are crucial for successful project management. It is essential that all members of an organization understand the significance of cost and its implications for organizational efficiency. A cost-conscious approach to cost management can be an effective method for achieving this (Oag & Williams, 2000).

2.3.3.2. Definition

Is the oil and gas project team members' awareness and attitude towards efficient resource use and minimizing waste and expenses.

2.3.3.3. Development

Establishing clear and achievable budget goals is crucial for developing a cost-conscious approach within your project team. By involving your team in the budget planning process, and clearly explaining the assumptions, risks, and limitations, you can foster a collective understanding of financial considerations. This will help your team work more effectively towards achieving financial goals.

2.3.3.4. Theories

The primary theory of cost consciousness is based on the assumption of 'waste not, want not'. Costs can be reduced through innovation.

2.3.3.5. Dimensions

Generally, businesses incur two types of costs: fixed and variable. Fixed costs, also known as overhead costs, remain constant regardless of output, while variable costs vary with output.

2.3.3.6. Explanations



Figure 4: Culture of Cost Consciousness (Jenkins & Crockford, 1975)

Equipping the team with the necessary tools, training, and resources to make cost-effective decisions, diving into data, encouraging innovation, and resetting performance management are key elements of a cost-conscious culture.

2.4. The relationship between the independent and the dependent variables

2.4.1. Literature Review-First Variable: Efficiency of Operations

The three variables, Efficiency of Operations, Budget, and Economy of Operations and Cost-Consciousness are interrelated in a positive way. This relationship is reflected positively in any project, specifically those that require huge resource input and result in high output. These projects do not just impact a small group of individuals, but also the economy of countries, as well as international investors who invest billions of dollars in global oil and gas projects.

2.4.2. Patterns

After summarizing all the studies conducted in the same field, specifically in the oil and gas industry, we can conclude that implementing optimization in the right way and addressing all relevant subjects during the planning phase of any project leads to the following positive outcomes:

- The efficiency of operations increases and can be monitored clearly.
- Budget and economic observations are used wisely, eliminating unnecessary wasteful investments in operations. This can be achieved by either replacing unneeded resources with more economically feasible solutions or by involving new solutions that will improve budget studies for oil and gas projects.

The project team, project managers, stakeholders, and investors will have an increased knowledge of cost consciousness, leading to better decision-making and minimum conflicts in a positive and supportive way (Lukawski et al., 2014).

2.4.3. Conflicts

Through a thorough examination and resolution of the variables listed above, we can ensure that any conflicts arising will be minimized, leading to increased success in the project. This will result in substantial savings in terms of resources and time, as the total planned days will be reduced to a minimum in the most efficient and cost-effective way possible.

It is important to note that conflicts between variables can arise if the pre-project planning is not given enough importance, and if corrective action is not taken in a timely manner during project monitoring and post-job evaluations. This can lead to delays in correcting the course of the project, which will be evident if stakeholders are not given routine feedback during the project life cycle. In addition, the involvement of outside resources, such as global economic decision-making processes, level of experience, global logistics cost, and manpower supply, are crucial to the success of any project, particularly oil and gas projects in upstream, midstream, or downstream investment projects.

2.4.4. Gaps

After reviewing several studies on the relationship between optimization and three variables, including Efficiency of Operations, Budget, and Economy of Operations and Cost-Consciousness, it was observed that most studies only covered the relationship between optimization and one of these variables, instead of examining all three together. This was particularly true for research studies related to projects in general or to the oil and gas industry.

This observation has piqued my interest in writing a research paper that examines the relationship between optimization and all three dependent variables in the oil and gas industry. Specifically, I plan to focus on ongoing projects related to the Saudi Aramco working environment for oil and gas projects, whether they have been completed, are ongoing, or are planned for the future (AbdulKarim et al., 2010).

By demonstrating the positive impact of optimization on all three dependent variables, including Efficiency of Operations, Budget, and Economy of Operations and Cost-Consciousness, we can fill the gap in the research and provide a more comprehensive understanding of the benefits of optimization in the oil and gas industry. This research will be applicable to upstream, midstream, and downstream projects in the industry.

2.5. Conclusion

After studying and analyzing optimization, we can conclude that it has a direct positive relationship with improving the efficiency and economy of operations, cost-consciousness, and budget. This improvement can be observed in any projects related to the oil and gas working environment, including projects completed under the supervision of Saudi Aramco. Throughout the upcoming semester, we will apply our studies and knowledge to real-life examples from the field. We look forward to continuing our research under her direct supervision and the team at Midocean University in the next phase.

3. Chapter 3: Research Methodology

3.1. Introduction

This chapter outlines the research methodology employed to investigate (The Impact of Optimization on Reducing Construction Costs in the Oil and Gas Sector in Dhahran, Saudi Arabia: A Case Study of Saudi Aramco's Projects). It details the operational definitions for research variables, research design, research population & sampling methods and technique, data collection methods, types of data , and data analysis methods & procedures.

3.2. Operational definitions for research variables

In research studies, operational definitions are key in clearly defining the variables being measured. An operational definition describes how a variable will be measured, observed, or manipulated. It helps researchers ensure that their studies are consistent, reliable, and valid.

3.2.1 The Independent Variable

I am selecting my main independent variable, as Optimization.

Operational Definition: Optimization, in its simplest form, refers to achieving the best available value or most favorable result under a given set of conditions or constraints.

3.2.2 The Dependent Variable

On my research, there are three main dependent variables, which are:

Operational efficiency, Budget and Economy of Operations and the third and last one is, Cost-Consciousness

The Operational Definition for the first dependent variable, Efficiency of Operations, the relationship between the output and input of an organization is vital for businesses to thrive.

The Operational Definition for the second dependent variable, Budget and Economy of Operations. is:

An operating budget is a detailed projection of an oil and gas company's expected revenue and expenses over a specific time period, often a year or the project life cycle.

Where the operational dependent for the third selected dependent variable, Cost-Consciousness, is:

The oil and gas project team members' awareness and attitude towards efficient resource use and minimizing waste and expenses.

3.3. Research Design (Research Onion)

On my research, I have followed the below set up:

- Research Philosophy: Interpretivist
- Research Approach: Inductive
- Research Strategy: Case Study
- Research Choice: Qualitative
- Time Horizon: Longitudinal
- Data Collection and Analysis Techniques: Statistical analysis of survey results

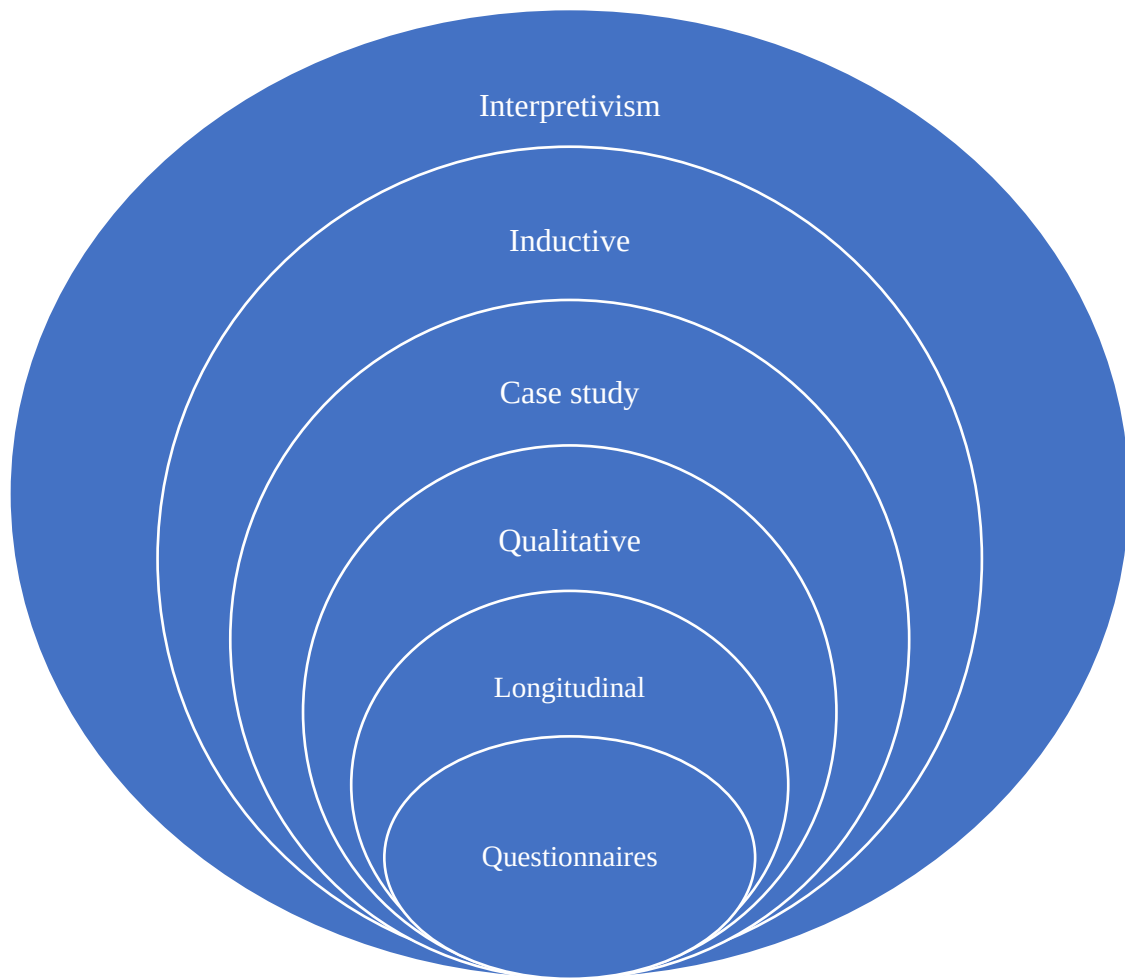


Figure 5: Proposed Research Methodology (The Researcher, 2024)

3.4. Research Population & Sampling Methods & Technique

This section provides information about the study population and sample, that was used during my research.

3.4.1 Research Population

Sector or Company name	Classifications	Number of employees
Saudi Aramco	Director	14
	Manager	22
	Engineer	24
	Employee	16
	Operational supportive team (Administrative)	14
	Total Population Size	90

Table 4:Research Population (The Researcher, 2024)

3.4.2 Research Sample

The research sample	Sample size
Target employees in Saudi Aramco company	20-50 employees

Table 5:Research Sample (The Researcher, 2024)

3.4.3 Sampling Method & Techniques

The sampling method is Probability and the sampling techniques is Simple Random Sampling.

3.5. Data collection method

The collected data will be analyzed Statistically. Statistical analysis involves identifying, analyzing, and turning raw data into useful information. This approach will help to uncover the key relationships between the Independent variable (Optimizations in operations) and the Dependent variables (Operational efficiency, Budget and Economy of Operations and Cost-Consciousness) at Saudi Aramco.

3.5.1 The independent variable

The researcher relied on the questionnaire of Shammass, P., Mr. (2000)..In order to measure the independent variable (Optimizations in operations), in terms of three dimensions: cost reduction, flexibility, and quality, overall 10 items for the entire variable. Whereas the cost reduction dimension consists of 4 elements, the flexibility dimension It consists of 3 elements, and the quality dimension consists of 3 elements.

Type of instrument is Likert: Strongly agree, agree, neutral, disagree, strongly disagree

Variable	Dimension	Number of items	Source
Optimizations in operations	Cost Reduction	4	Shammass, P., Mr. (2000).
	Flexibility	3	
	Quality	3	
	Overall	10	

Table 6: Independent variable (The Researcher, 2024)

3.5.2 The Dependent Variable

The researcher relied on on the questionnaire of Solares, J. R., Mr. (2001). In order to measure the independent variable (project success), in terms of one dimension, which is the projects' success with the total

10 items for the entire variables.

The instrument type is Likert: Strongly agree, agree, neutral, disagree, strongly disagree

Variable	Dimension	Number of items	Source
Operational efficiency	6	27	Solares, J. R., Mr. (2001).
Budget and Economy of Operations	6	27	
Cost-Consciousness	6	27	
Overall	18	81	

Table 7: Dependent variable (The Researcher, 2024)

3.6. Types Of Data

3.6.1 Primary Data

Primary data refers to the data that the researcher collects directly from original sources. It is authentic and unique data that represents the focus of the study. The main objective of collecting primary data is to address the research problem. Examples of primary data collection methods include interviews, questionnaires, and observations. For my research, I have opted for the questionnaire method, using the set of questions provided below. These questionnaires will be distributed to the specific client team included in my research sample.

3.6.2 Secondary Data

Secondary data refers to information collected by other researchers. It involves the analysis and interpretation of primary data for purposes other than solving the specific research problem. This type of data may provide valuable information to support scientific writing. Examples of secondary data sources include books, articles, periodicals, and official reports, which have already been included in my references for this research.

3.7. Data Analysis Methods & Procedures

After collecting data, it is essential to analyze the information gathered to draw meaningful conclusions. The Statistical Package for the Social Sciences (SPSS), specifically version 28, was used to analyze the collected data. The sample profile test was conducted through descriptive analysis to gain insights into the characteristics of the sample population. This helps researchers understand the demographics, preferences, and other relevant information about the individuals involved in the study. Validity and reliability tests are crucial in ensuring that the collected data is accurate and consistent. Validity tests (Exploratory factor analysis) are used to determine if the research instruments measure what they are intended to measure, while reliability tests (Cronbach's Alpha test) assess the consistency of results over time.

3.8. Conclusion

By applying thorough analysis techniques to the research questionnaire from the selected population, we can determine the main factors that need to be highlighted. Additionally, we can examine the relationship between different independent and dependent variables. This analysis can help fill the gaps in historical research studies on similar operator companies in the Middle East region or in the GCC, with a specific

focus on Saudi Aramco engineering and operations. These operations are centered around construction projects for the oil and gas sector in Dhahran.

4. Chapter 4: Statistical Analysis & Findings discussion

4.1. Introduction

This chapter presents the results of the field study that were statistically analyzed using the statistical programs **SPSS** version **28**. The current chapter of statistical analysis includes descriptive statistics for the sample under study using **SPSS** version **28**. Testing the validity and reliability of the questionnaires used to collect the required data from the current study sample. In order to test the research hypotheses and the suitability of the model, simple linear regression analysis was conducted via **SPSS 28**.

4.2. Sample profile (descriptive statistics for research sample)

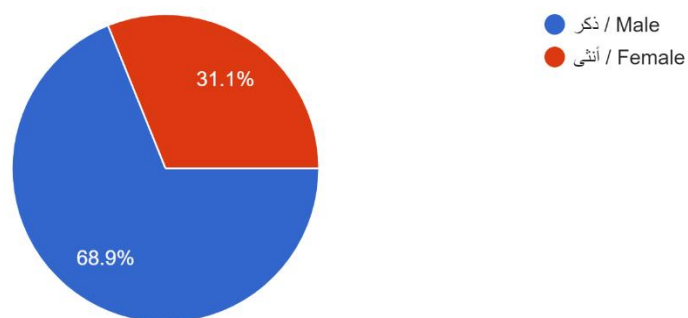
The study sample was distributed according to gender - age group - number of years of experience nature of work and educational level.

- Frequencies and percentages were calculated for the study sample members and are represented by demographic information that includes:
 - o Gender includes (male, female).
 - o The age group includes (less than 30 years, from 30 to 40 years, from 41 to 50 years, and more than 50 years).
 - o Number of years of experience, including (less than 5 years, from 5 to 10 years, from 11 to 20 years, from 21 years or more).
 - o Nature of work, including (leaders/employees/technicians)
 - o Educational level, includes (secondary/university/postgraduate)

Variable	Variable Classes	The Number	Percentage of the total sample
Gender	Male	31	68.90%
	Female	14	31.10%
	Total	45	100%
The age group	Less than 20 years	4	8.90%
	From 20 to 30 years	10	22.20%
	From 31 to 40 years	11	24.40%
	From 41 to 50 years	13	28.90%
	From 51 to 60 years	7	15.60%
	Total	45	100%
Marital status	Single	10	22.20%
	Married	17	37.80%
	Divorced	13	28.90%
	Widower	5	11.10%
	Total	45	100%
Qualification	High School	10	22.20%
	Diploma	6	13.30%
	Bachelor's	13	28.90%
	Master's	10	22.20%
	Ph.D.	6	13.30%
	Total	45	100%
Function	Administrative	7	15.60%
	Employee	8	17.80%
	Engineer	12	26.70%
	Manager	11	24.40%
	Director	7	15.60%
	Total	45	100%
Years of Experience	Less than one year	8	17.80%
	From 1 year to 4 years	12	26.70%
	From 5 years to 10 years	13	28.90%
	More than 10 years	12	26.70%
	Total	45	100%

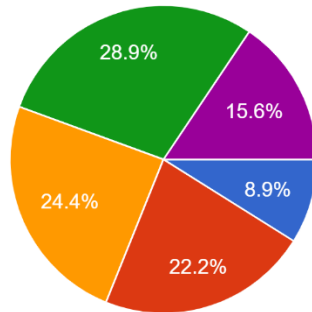
Section One: Personal and Professional Information:

45 responses



العمر / Age

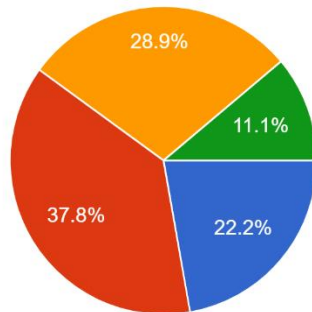
45 responses



- أقل من ٢٠ سنة / Less than 20 years
- ٢٠ سنة - ٣٠ سنة / 20 years - 30 years
- ٣١ سنة - ٤٠ سنة / 31 years - 40 years
- ٤١ سنة - ٥٠ سنة / 41 years - 50 years
- ٥١ سنة - ٦٠ سنة / 51 years - 60 years

الحالة الاجتماعية / Marital status

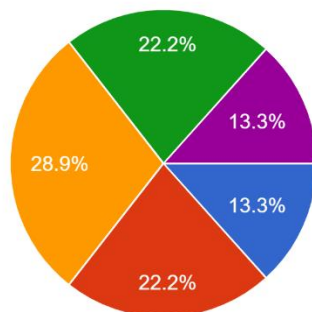
45 responses



- أعزب أو عزباء / Single
- متزوج أو متزوجة / Married
- مطلق أو مطلقة / Divorced
- أرمل أو أرملة / Widower

المؤهل العلمي / Qualification

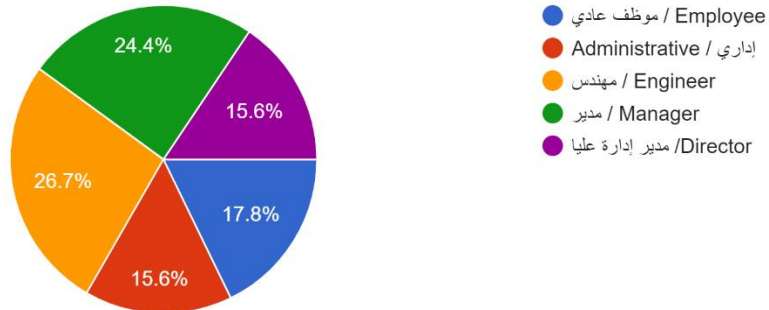
45 responses



- دبلوم / Diploma
- ثانوي / High School
- بكالوريوس / Bachelor's
- ماجستير / Master's
- دكتوراه / Ph.D

Function / الوظيفة

45 responses



Years of Experience / عدد سنوات الخبرة

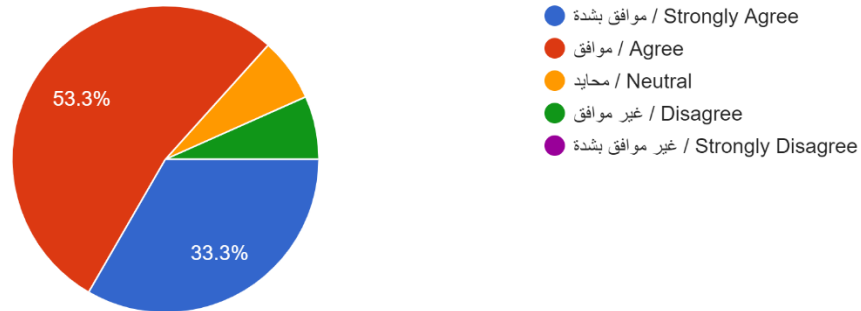
45 responses



Efficiency of Operations (Dependent Variable # One)

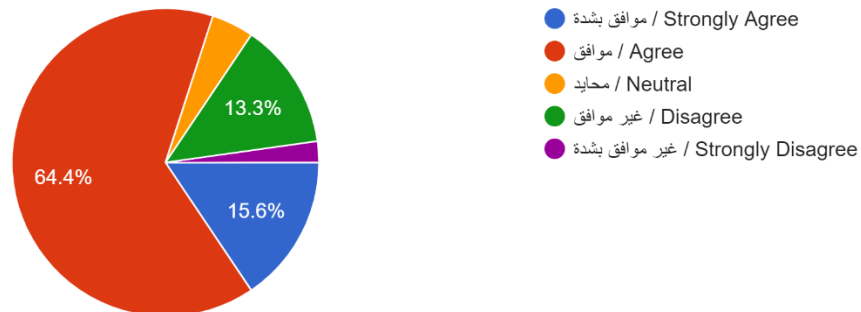
All Parties-related causes: Efficiency in oil and gas construction projects can be affected by the following: Incompetent project team

45 responses



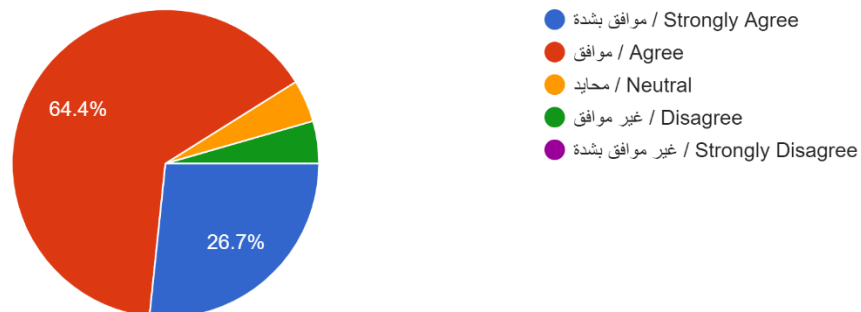
All Parties-related causes: Efficiency in oil and gas construction projects can be affected by the following: Personality clash between two or mor...members/service companies from different parties

45 responses



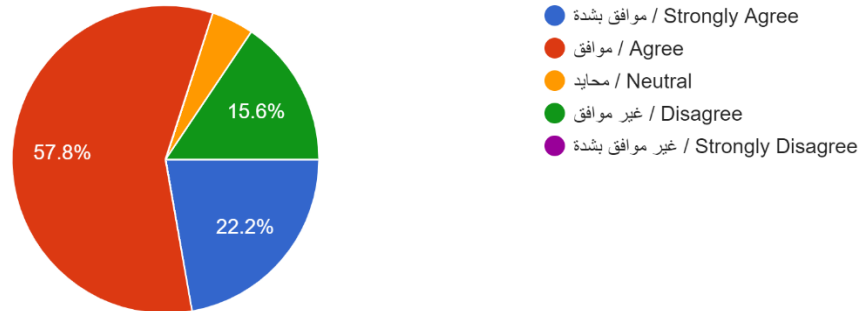
All Parties-related causes: Efficiency in oil and gas construction projects can be affected by the following: Poor planning and scheduling of the project.

45 responses



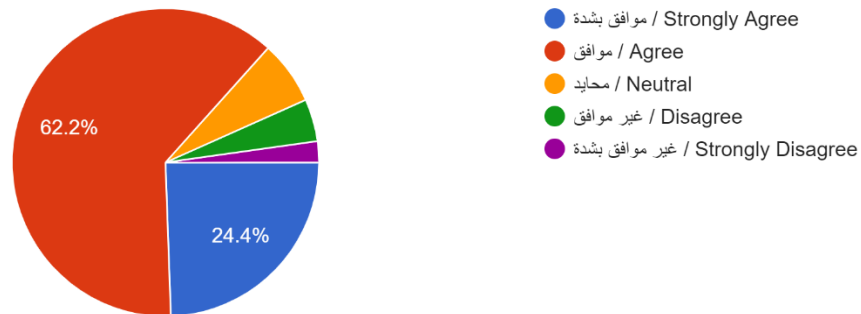
Consultant/designer-related causes: Efficiency in oil and gas construction projects can be affected due to: Design errors

45 responses



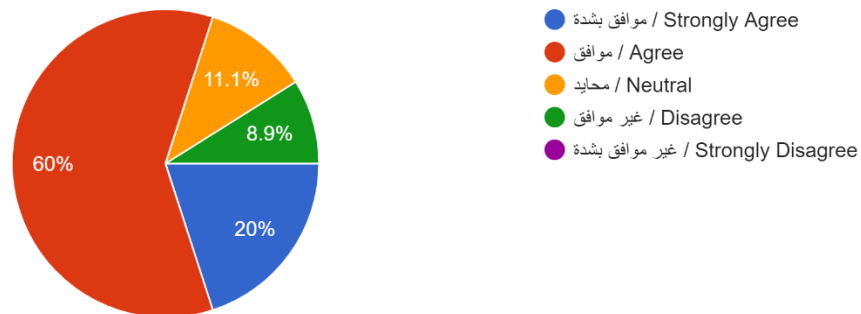
Consultant/designer-related causes: Efficiency in oil and gas construction projects can be affected due to: Inadequate cost estimating approach / inaccurate material estimation

45 responses



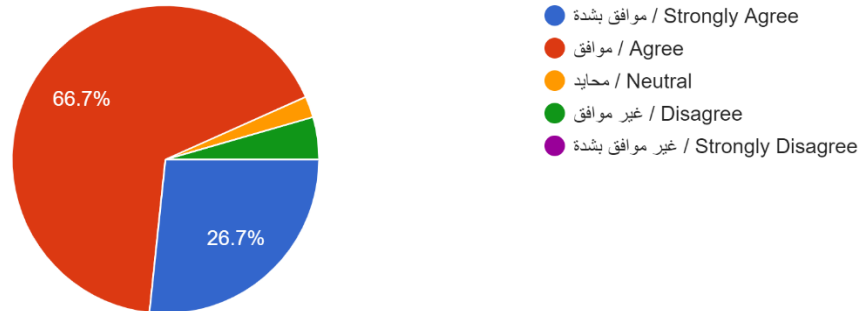
Consultant/designer-related causes: Efficiency in oil and gas construction projects can be affected due to: Inadequate quality control/assurance

45 responses



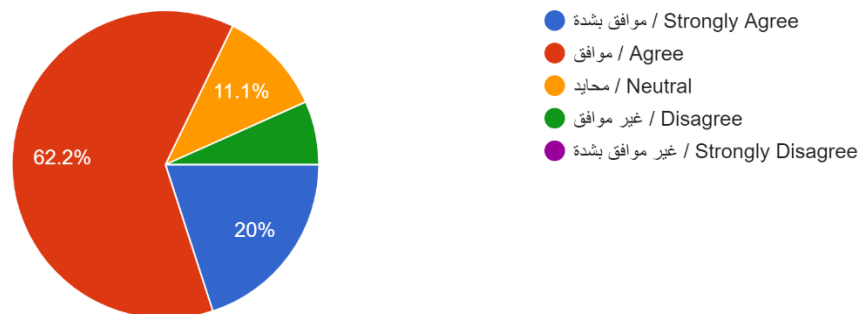
Consultant/designer-related causes: Efficiency in oil and gas construction projects can be affected due to: Inadequate management of contractor's schedule by consultant

45 responses



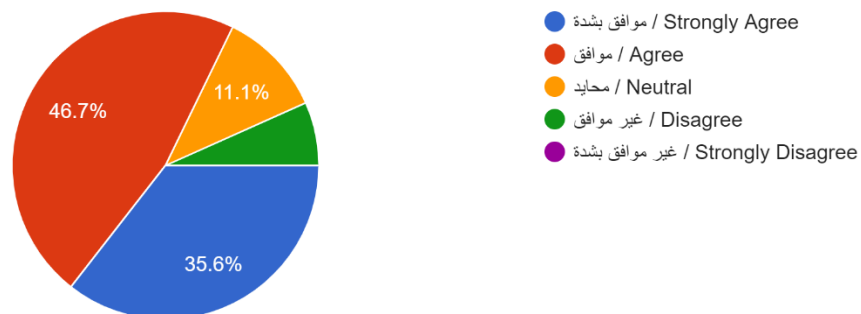
Consultant/designer-related causes: Efficiency in oil and gas construction projects can be affected due to: Unforeseen conditions and structural modifications

45 responses



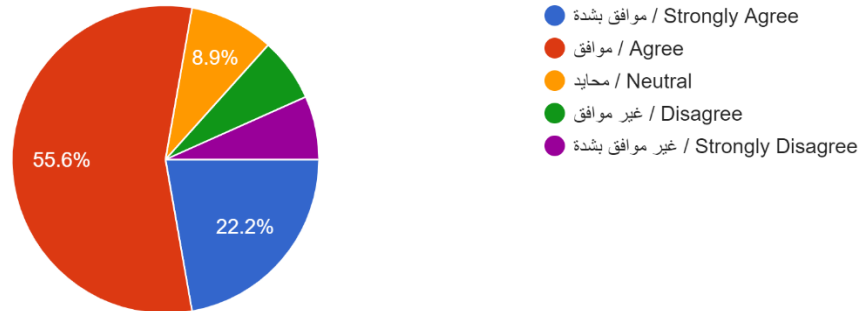
Consultant/designer-related causes: Efficiency in oil and gas construction projects can be affected due to: Weak and insufficient technical studies

45 responses



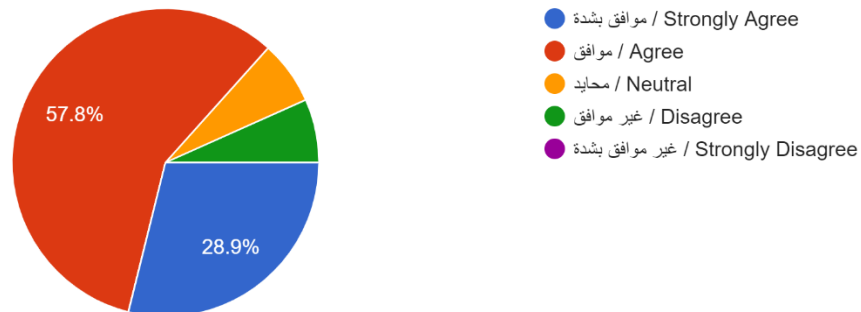
Contract-related causes: Efficiency in oil and gas construction projects can be affected due to: Poor communication among the parties

45 responses



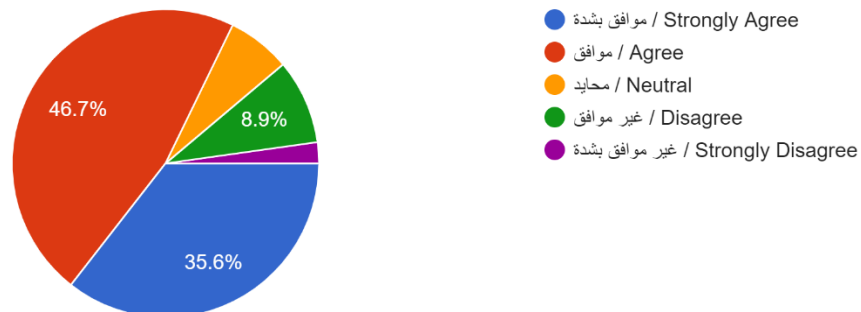
Contract-related causes: Efficiency in oil and gas construction projects can be affected due to: Discrepancies in contract documents

45 responses



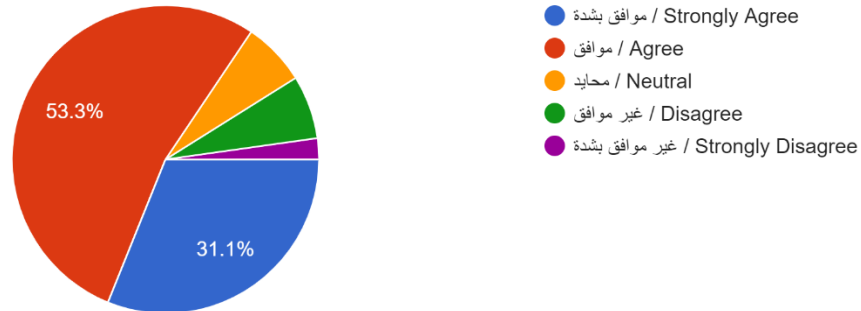
Contract-related causes: Efficiency in oil and gas construction projects can be affected due to: Poorly defined payment milestones

45 responses



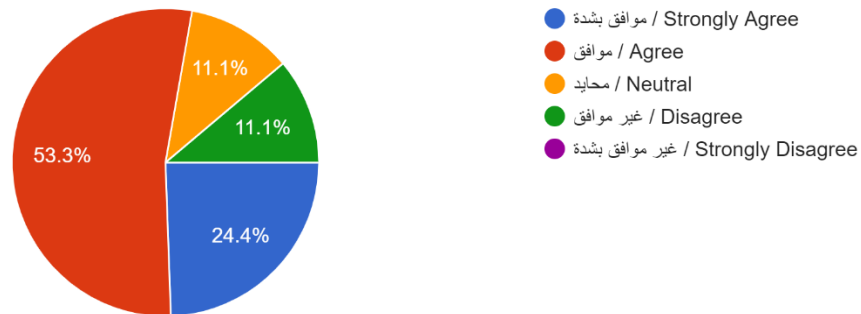
Contract-related causes: Efficiency in oil and gas construction projects can be affected due to: Lack of communication with suppliers in the engineering and procurement phases

45 responses



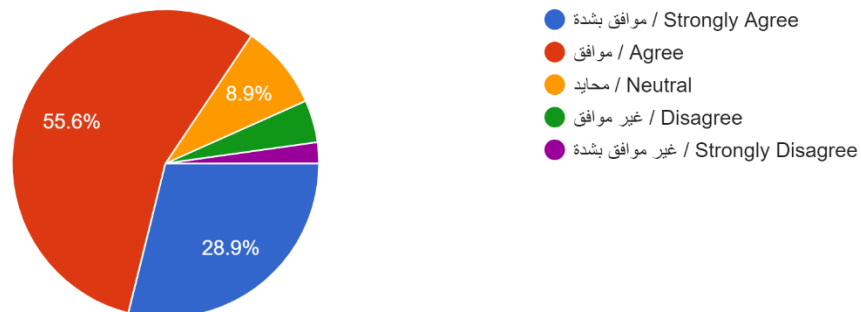
Contract-related causes: Efficiency in oil and gas construction projects can be affected due to: Poor project implementation strategies

45 responses



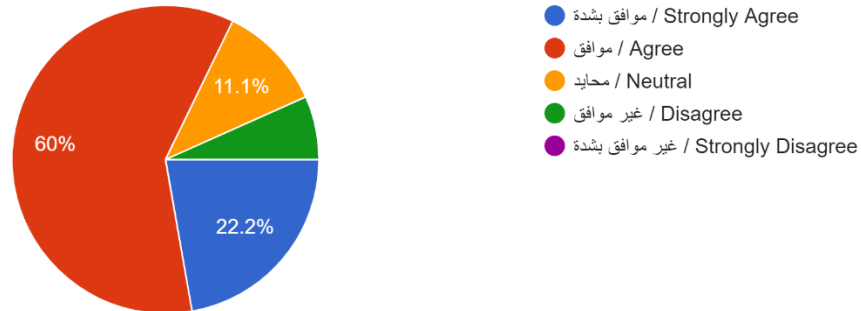
External-related causes: Efficiency in oil and gas construction projects can be affected due to: Impact of weather conditions on work

45 responses



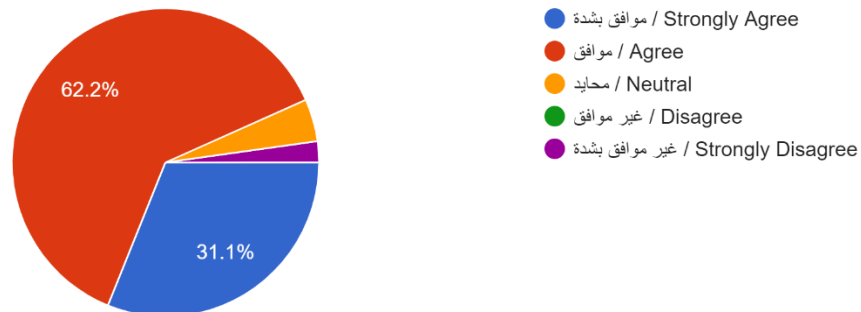
External-related causes: Efficiency in oil and gas construction projects can be affected due to: Impact of formation's stability on work

45 responses



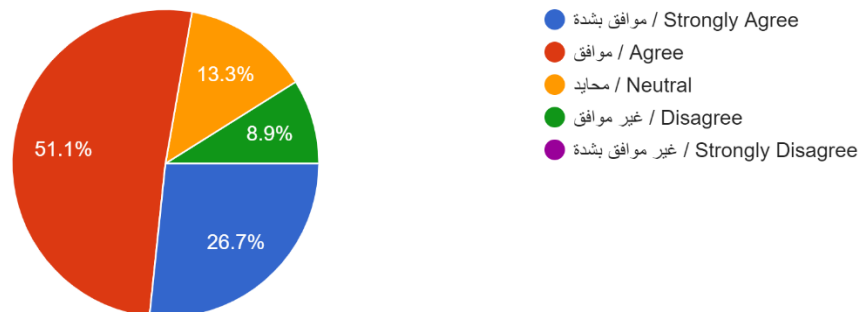
External-related causes: Efficiency in oil and gas construction projects can be affected due to: Impact of sea's condition on work

45 responses



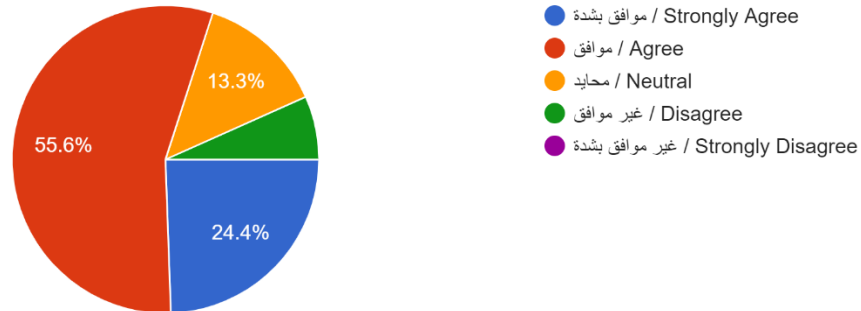
External-related causes: Efficiency in oil and gas construction projects can be affected due to: Impact of onshore/offshore' s location on work

45 responses



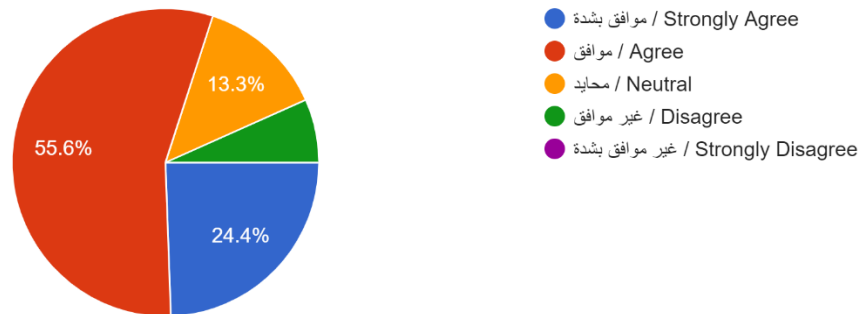
Owner-related causes: Efficiency in oil and gas construction projects can be affected due to: Deficient documentation and incomplete scope definition

45 responses



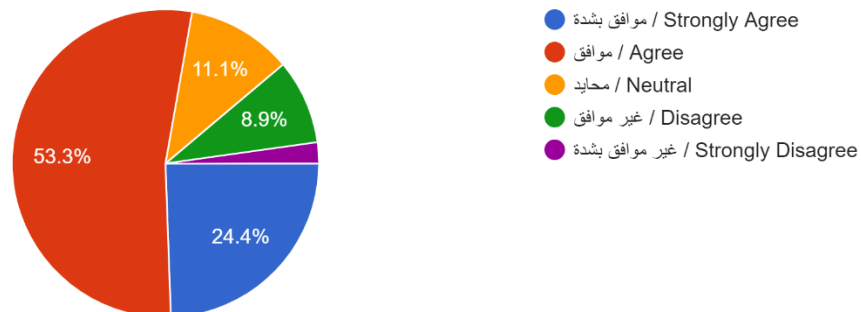
Owner-related causes: Efficiency in oil and gas construction projects can be affected due to: Deficient documentation and incomplete scope definition

45 responses



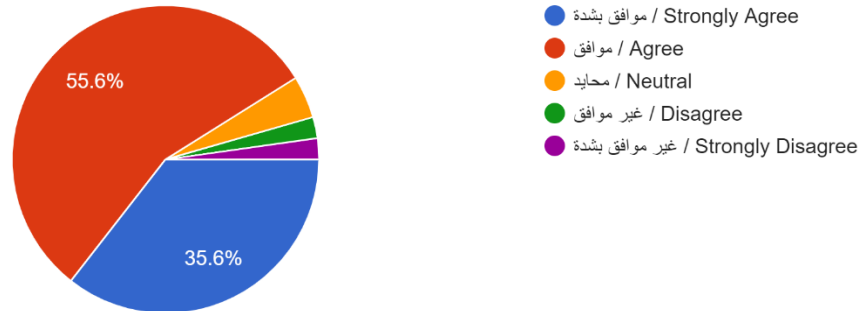
Owner-related causes: Efficiency in oil and gas construction projects can be affected due to: Changing of design and scope by client during construction

45 responses



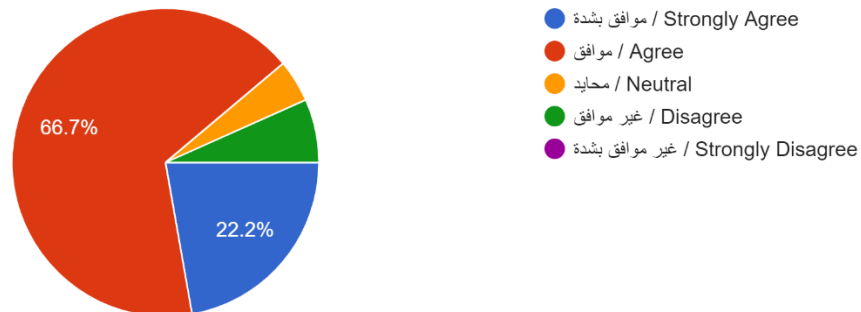
Owner-related causes: Efficiency in oil and gas construction projects can be affected due to: Long project approval procedures

45 responses



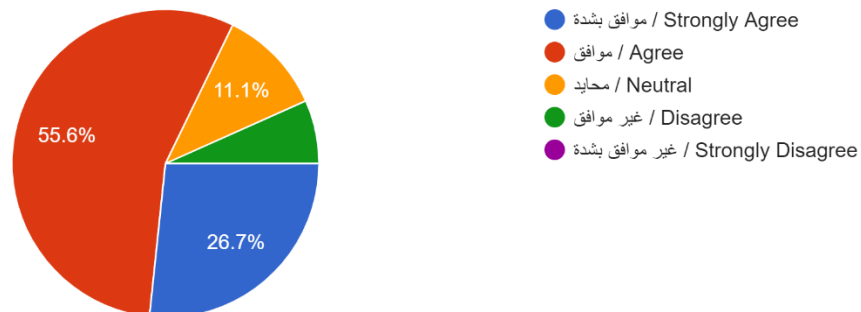
Owner-related causes: Efficiency in oil and gas construction projects can be affected due to: Many stakeholders

45 responses



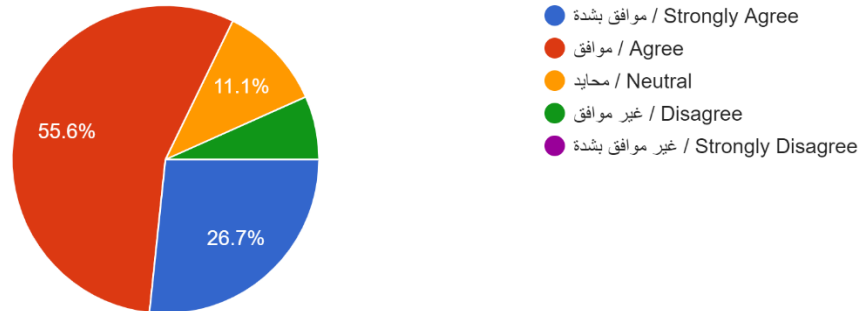
Owner-related causes: Efficiency in oil and gas construction projects can be affected due to: Poor definition of subsurface data

45 responses



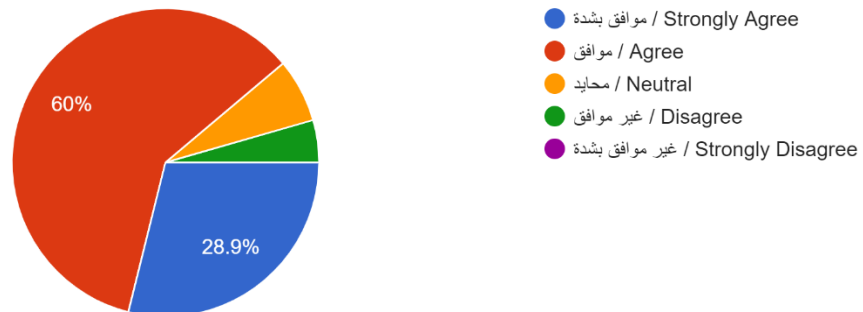
Owner-related causes: Efficiency in oil and gas construction projects can be affected due to: Poor definition of subsurface data

45 responses



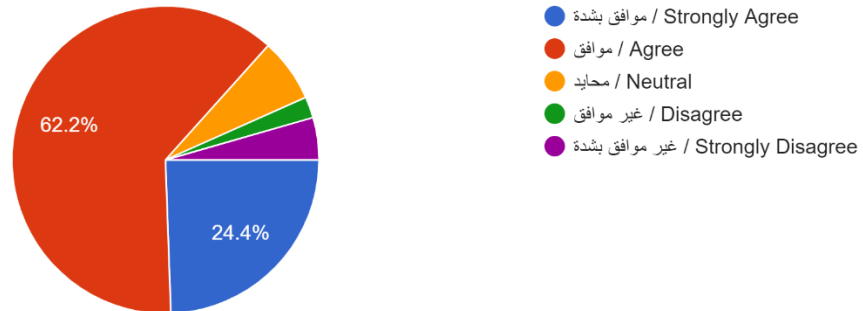
Resources-related causes: Efficiency in oil and gas construction projects can be affected due to: Labor's lack of skills and productivity

45 responses



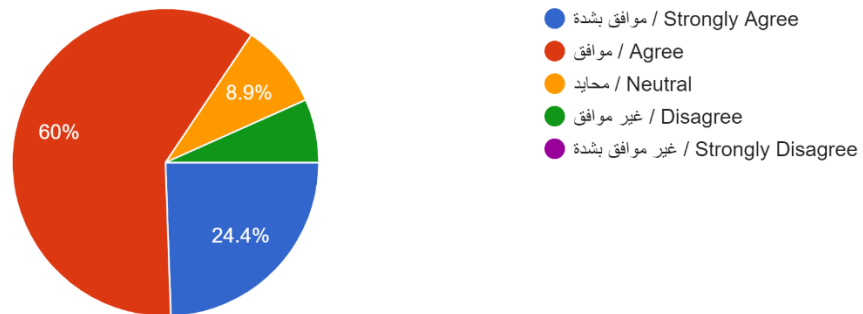
Resources-related causes: Efficiency in oil and gas construction projects can be affected due to: Lack of equipment

45 responses



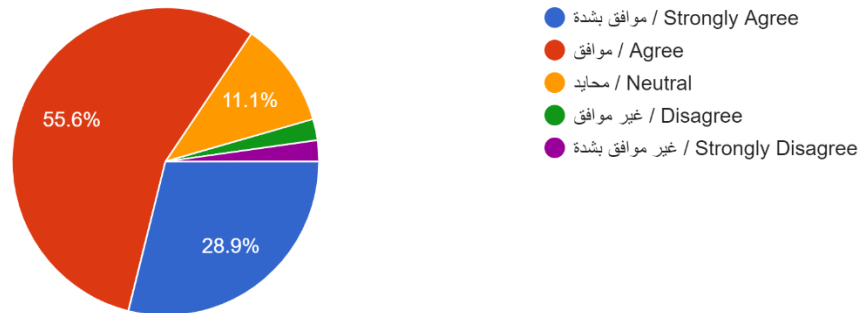
Resources-related causes: Efficiency in oil and gas construction projects can be affected due to: Manpower shortage

45 responses



Resources-related causes: Efficiency in oil and gas construction projects can be affected due to: Material procurement issues

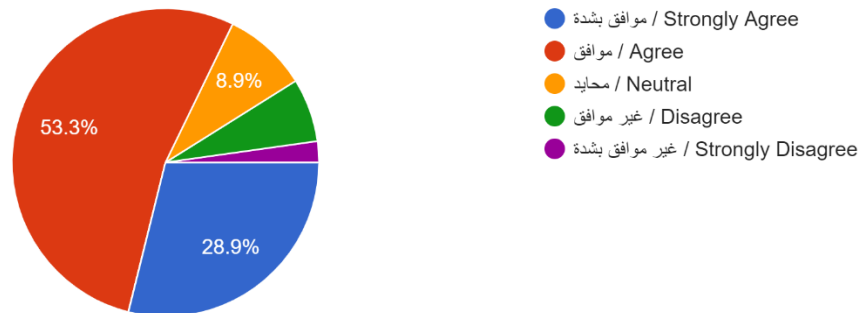
45 responses



Budget and Economy of Operations (Dependent Variable # Two)

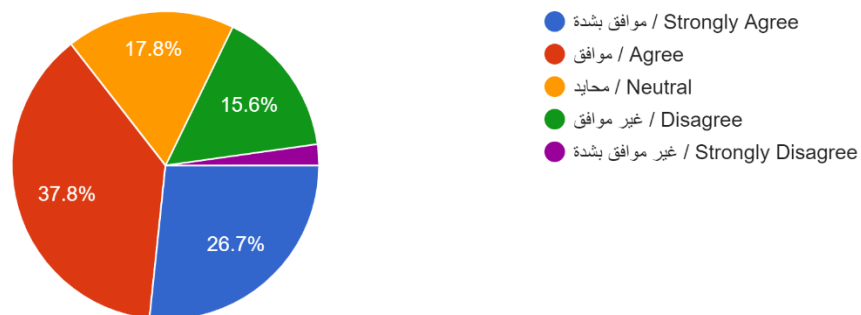
All Parties-related causes: Project Budget and Economy in oil and gas construction projects can be affected by the following: Incompetent project team

45 responses



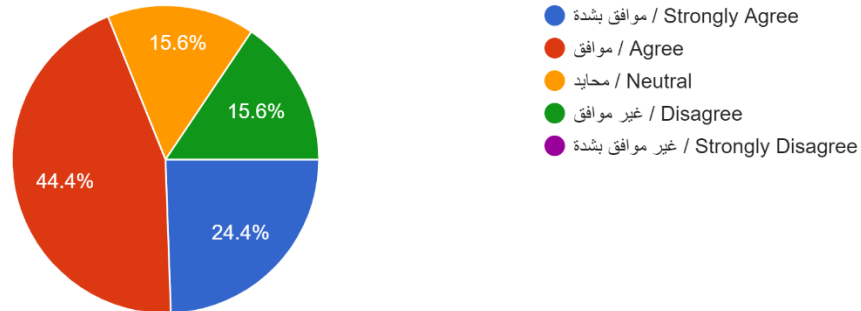
All Parties-related causes: Project Budget and Economy in oil and gas construction projects can be affected by the following: Personality clash bet... members/service companies from different parties

45 responses



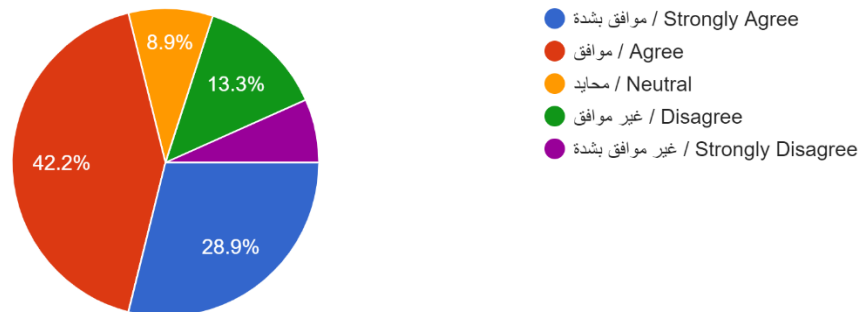
All Parties-related causes: Project Budget and Economy in oil and gas construction projects can be affected by the following: Poor planning and scheduling of the project.

45 responses



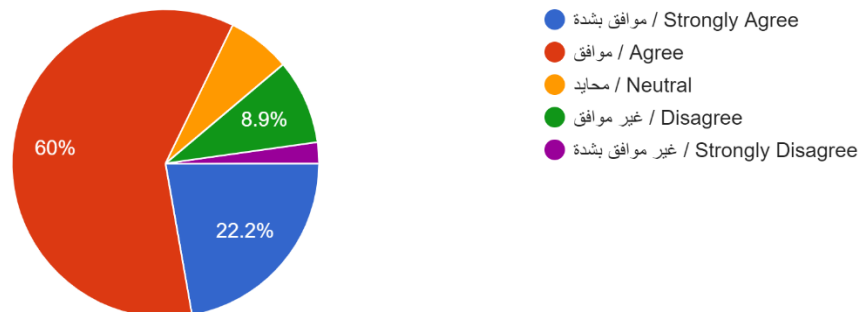
Consultant/designer-related causes: Project Budget and Economy in oil and gas construction projects can be affected due to: Design errors

45 responses



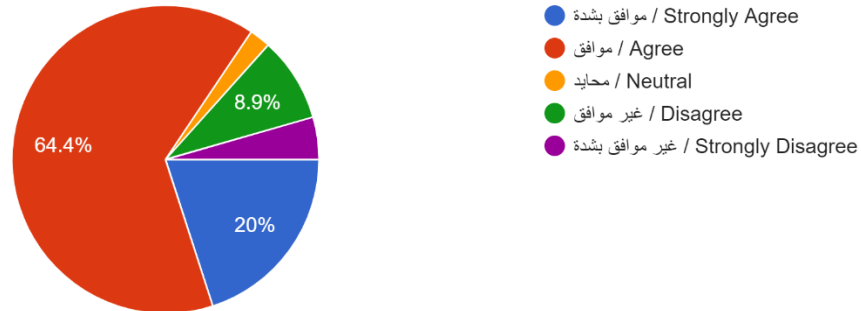
Consultant/designer-related causes: Project Budget and Economy in oil and gas construction projects can be affected due to: Inadequate cost ...imating approach / inaccurate material estimation

45 responses



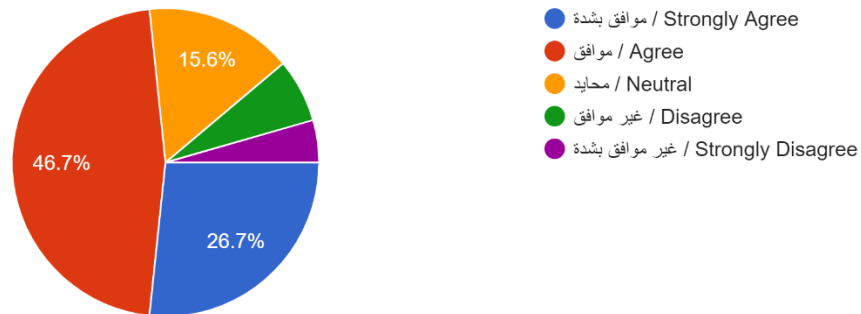
Consultant/designer-related causes: Project Budget and Economy in oil and gas construction projects can be affected due to: Inadequate quality control/assurance

45 responses



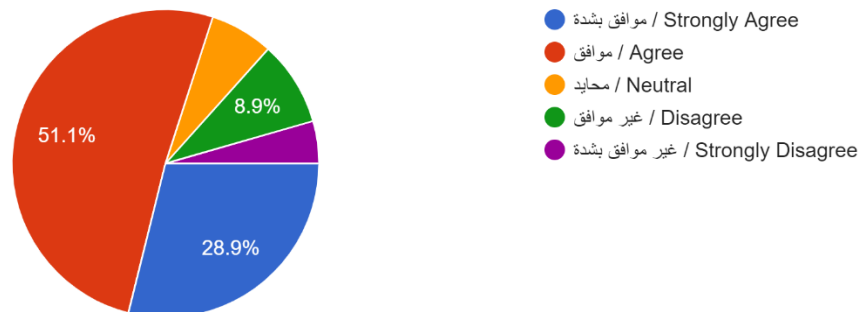
Consultant/designer-related causes: Project Budget and Economy in oil and gas construction projects can be affected due to: Inadequate management of contractor's schedule by consultant

45 responses



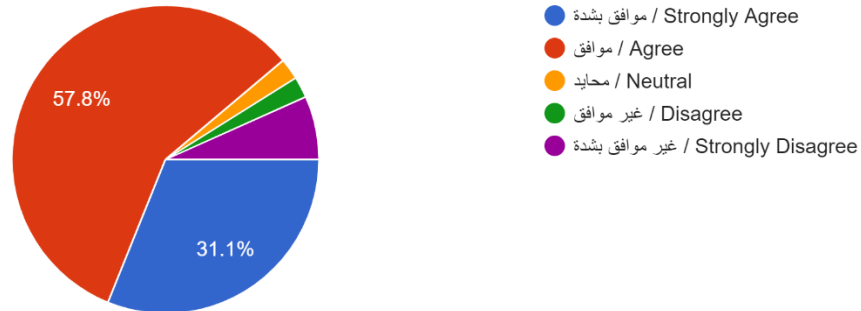
Consultant/designer-related causes: Project Budget and Economy in oil and gas construction projects can be affected due to: Unforeseen conditions and structural modifications

45 responses



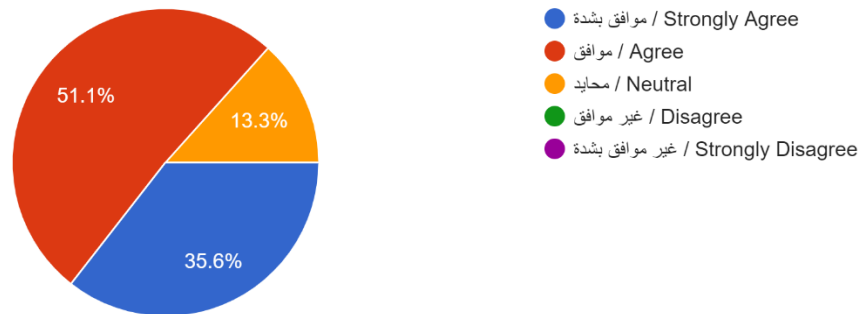
Consultant/designer-related causes: Project Budget and Economy in oil and gas construction projects can be affected due to: Weak and insufficient technical studies

45 responses



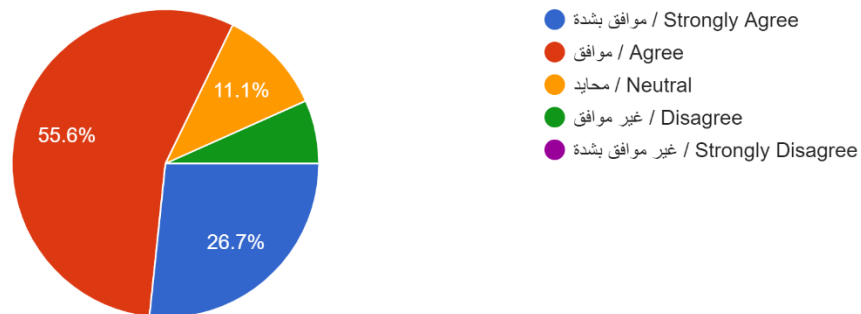
Contract-related causes: Project Budget and Economy in oil and gas construction projects can be affected due to: Poor communication among the parties

45 responses



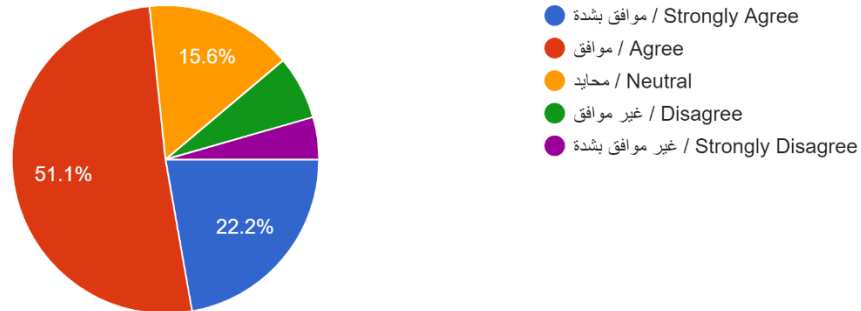
Contract-related causes: Project Budget and Economy in oil and gas construction projects can be affected due to: Discrepancies in contract documents

45 responses



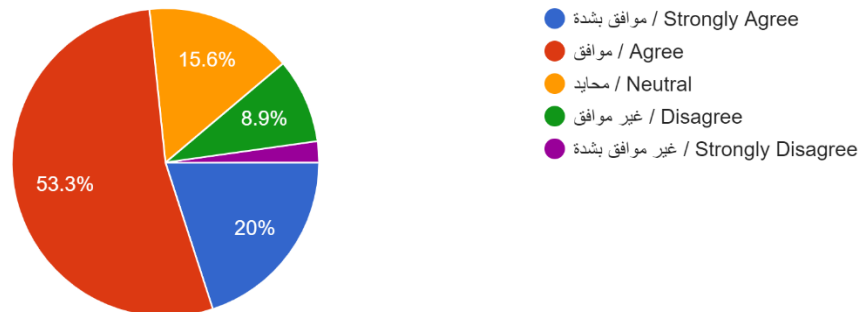
Contract-related causes: Project Budget and Economy in oil and gas construction projects can be affected due to: Poorly defined payment milestones

45 responses



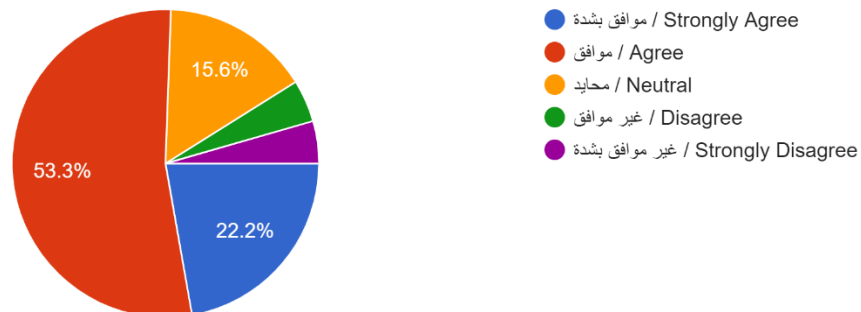
Contract-related causes: Project Budget and Economy in oil and gas construction projects can be affected due to: Lack of communication with suppliers in the engineering and procurement phases

45 responses



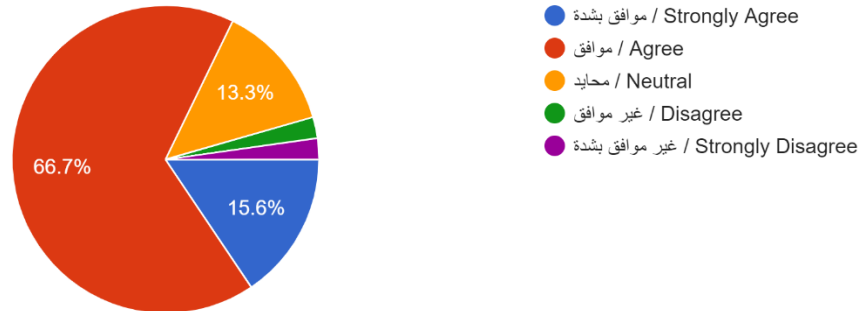
Contract-related causes: Project Budget and Economy in oil and gas construction projects can be affected due to: Poor project implementation strategies

45 responses



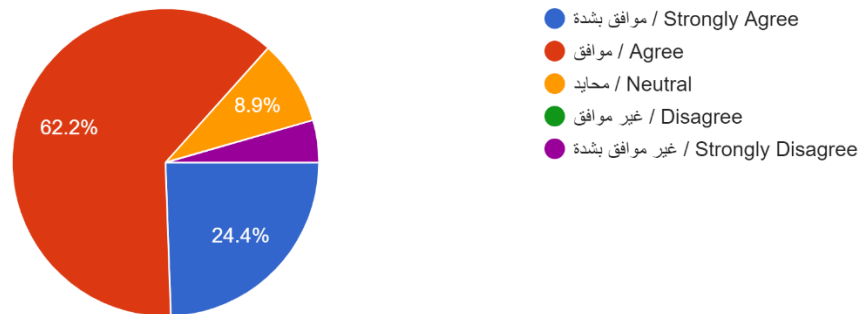
External-related causes: Project Budget and Economy in oil and gas construction projects can be affected due to: Impact of weather conditions on work

45 responses



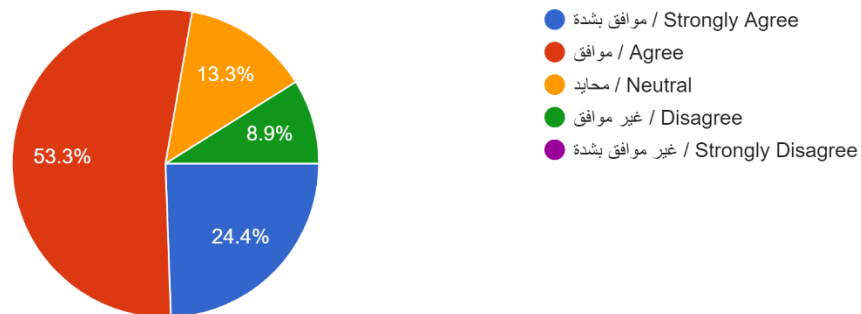
External-related causes: Project Budget and Economy in oil and gas construction projects can be affected due to: Impact of formation's stability on work

45 responses



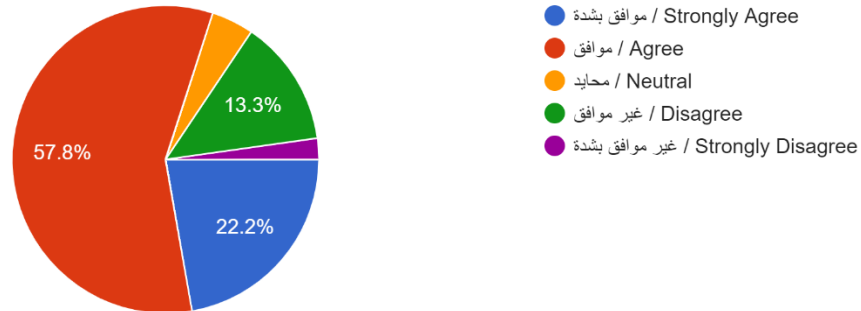
External-related causes: Project Budget and Economy in oil and gas construction projects can be affected due to: Impact of sea's condition on work

45 responses



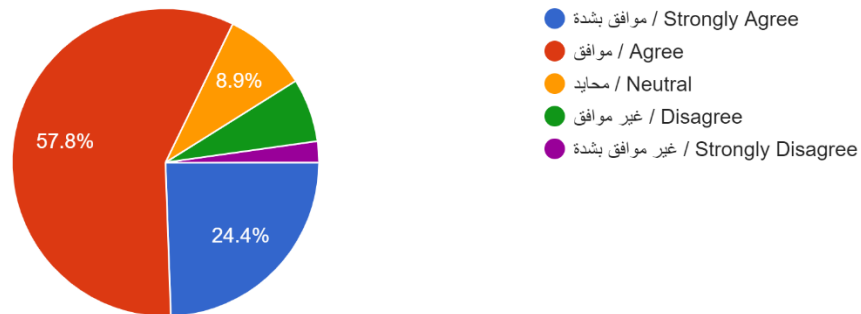
External-related causes: Project Budget and Economy in oil and gas construction projects can be affected due to: Impact of onshore/offshore' s location on work

45 responses



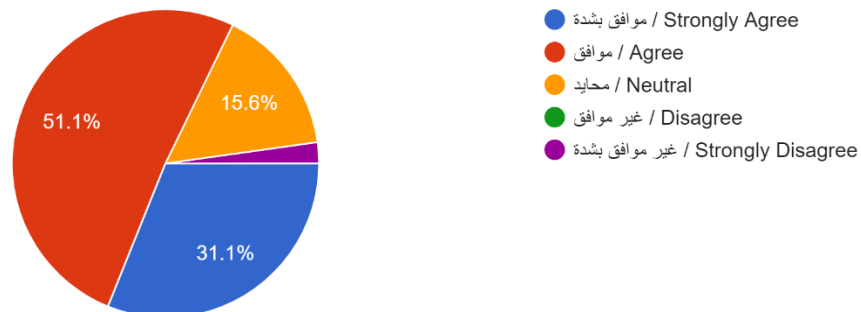
Owner-related causes: Project Budget and Economy in oil and gas construction projects can be affected due to: Deficient documentation and incomplete scope definition

45 responses



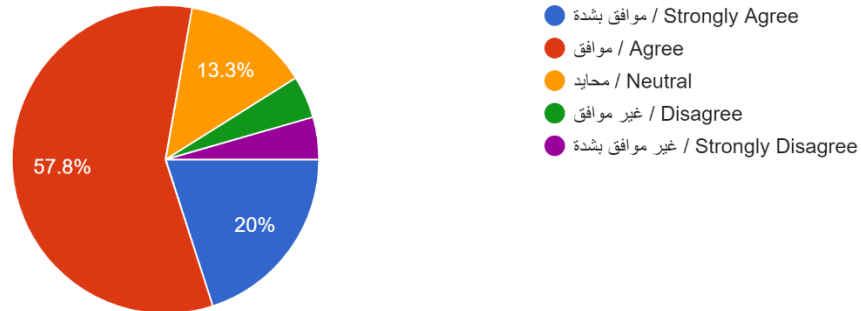
Owner-related causes: Project Budget and Economy in oil and gas construction projects can be affected due to: Changing of design and scope by client during construction

45 responses



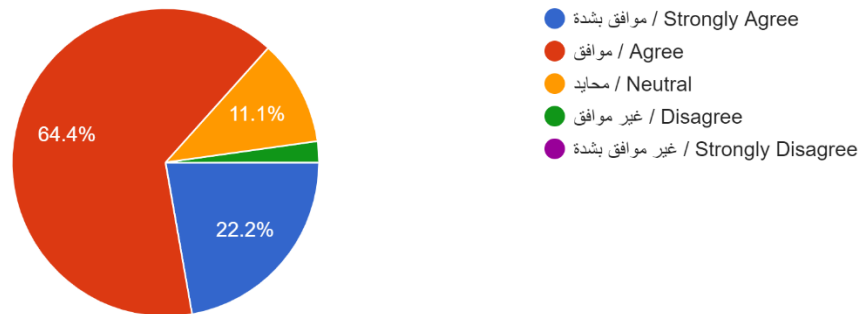
Owner-related causes: Project Budget and Economy in oil and gas construction projects can be affected due to: Long project approval procedures

45 responses



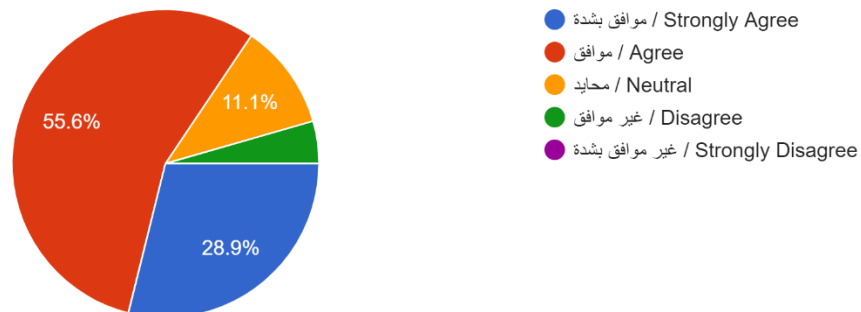
Owner-related causes: Project Budget and Economy in oil and gas construction projects can be affected due to: Many stakeholders

45 responses



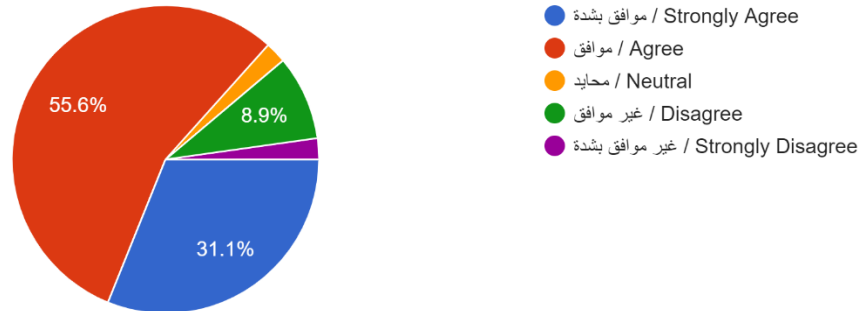
Owner-related causes: Project Budget and Economy in oil and gas construction projects can be affected due to: Poor definition of subsurface data

45 responses



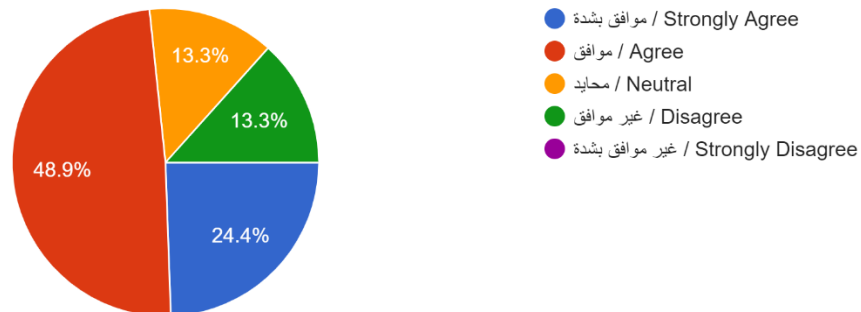
Resources-related causes: Project Budget and Economy in oil and gas construction projects can be affected due to: Labor's lack of skills and productivity

45 responses



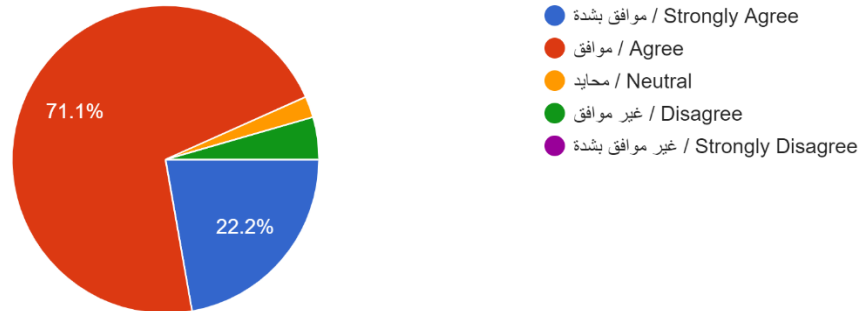
Resources-related causes: Project Budget and Economy in oil and gas construction projects can be affected due to: Lack of equipment

45 responses



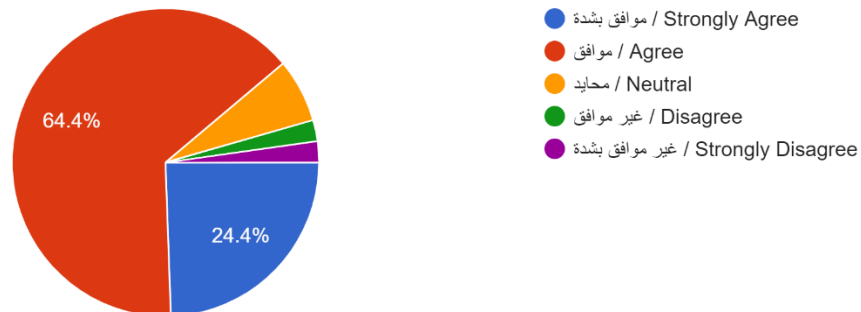
Resources-related causes: Project Budget and Economy in oil and gas construction projects can be affected due to: Manpower shortage

45 responses



Resources-related causes: Project Budget and Economy in oil and gas construction projects can be affected due to: Material procurement issues

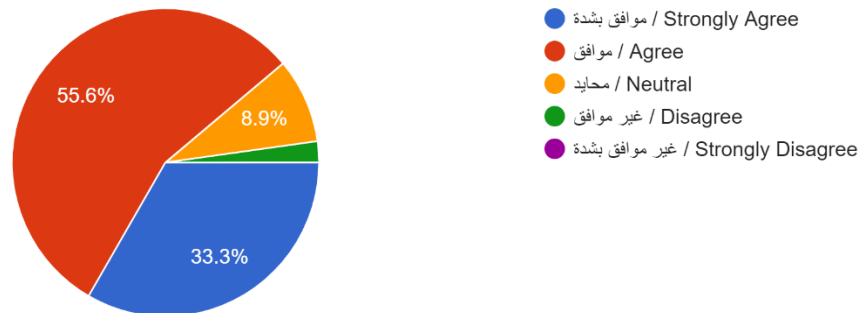
45 responses



Cost-Consciousness of Operations (Dependent Variable # Three)

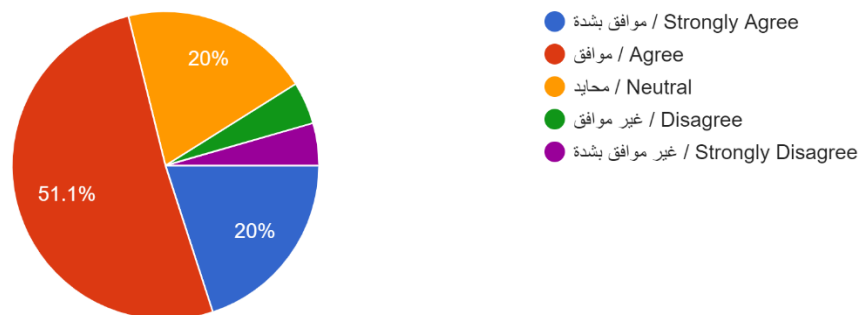
All Parties-related causes: Cost-Consciousness in oil and gas construction projects can be affected by the following: Incompetent project team

45 responses



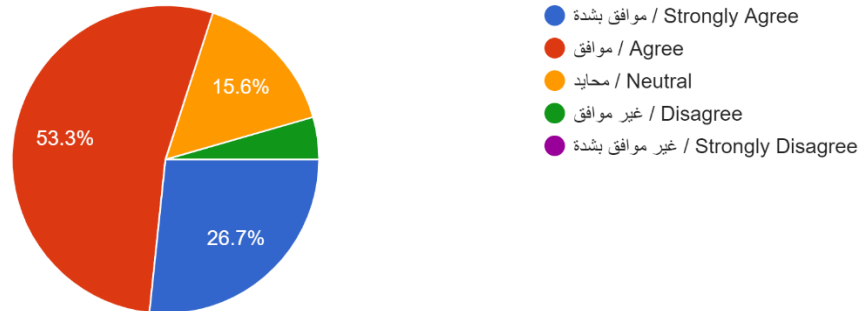
All Parties-related causes: Cost-Consciousness in oil and gas construction projects can be affected by the following: Personality clash between two...members/service companies from different parties

45 responses



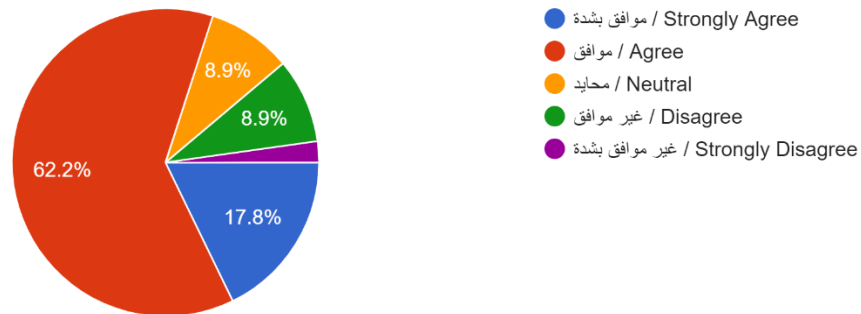
All Parties-related causes: Cost-Consciousness in oil and gas construction projects can be affected by the following: Poor planning and scheduling of the project.

45 responses



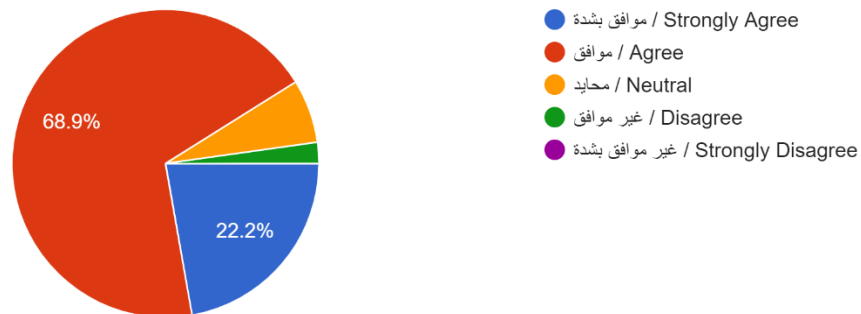
Consultant/designer-related causes: Cost-Consciousness in oil and gas construction projects can be affected due to: Design errors

45 responses



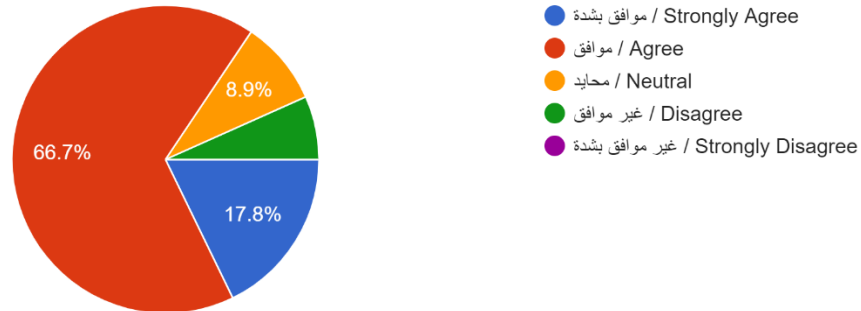
Consultant/designer-related causes: Cost-Consciousness in oil and gas construction projects can be affected due to: Inadequate cost estimating approach / inaccurate material estimation

45 responses



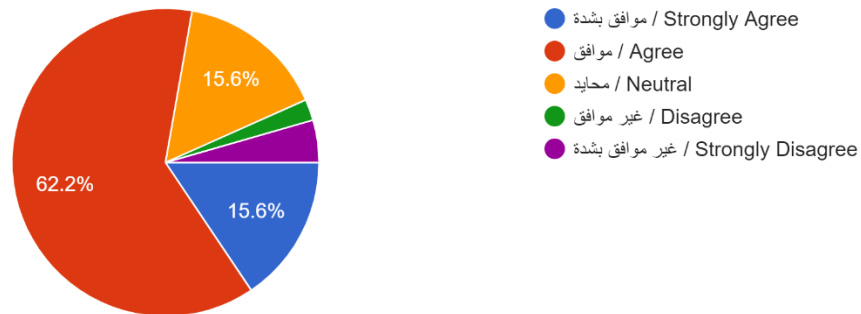
Consultant/designer-related causes: Cost-Consciousness in oil and gas construction projects can be affected due to: Inadequate quality control/assurance

45 responses



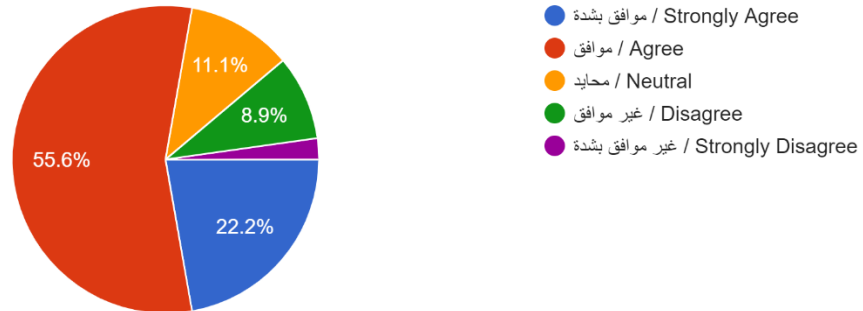
Consultant/designer-related causes: Cost-Consciousness in oil and gas construction projects can be affected due to: Inadequate management of contractor's schedule by consultant

45 responses



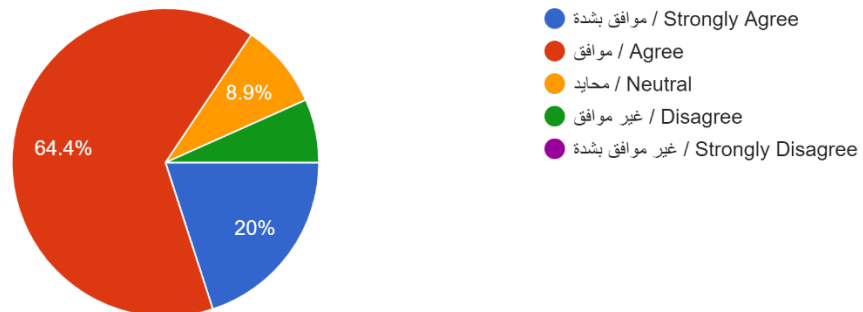
Consultant/designer-related causes: Cost-Consciousness in oil and gas construction projects can be affected due to: Unforeseen conditions and structural modifications

45 responses



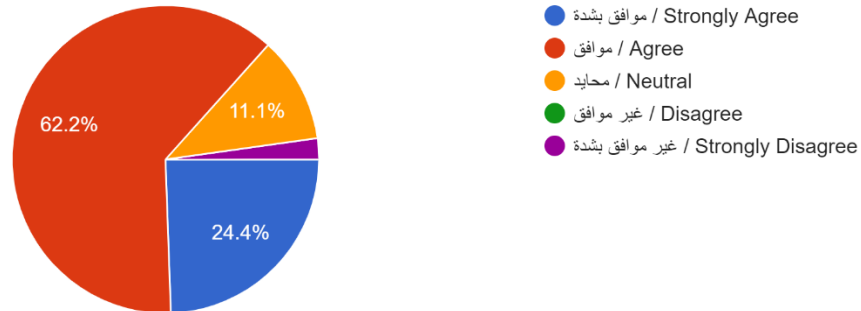
Consultant/designer-related causes: Cost-Consciousness in oil and gas construction projects can be affected due to: Weak and insufficient technical studies

45 responses



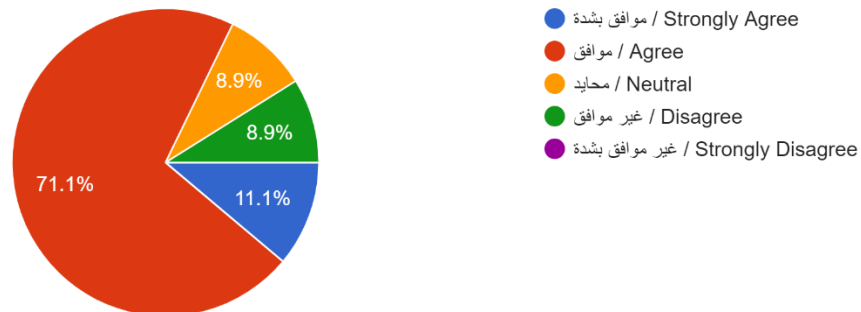
Contract-related causes: Cost-Consciousness in oil and gas construction projects can be affected due to: Poor communication among the parties

45 responses



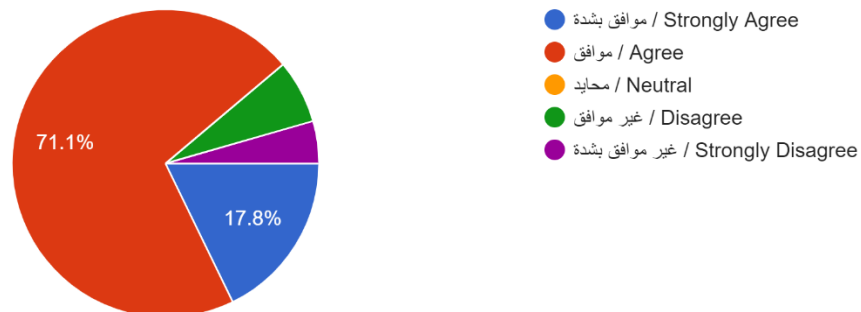
Contract-related causes: Cost-Consciousness in oil and gas construction projects can be affected due to: Discrepancies in contract documents

45 responses



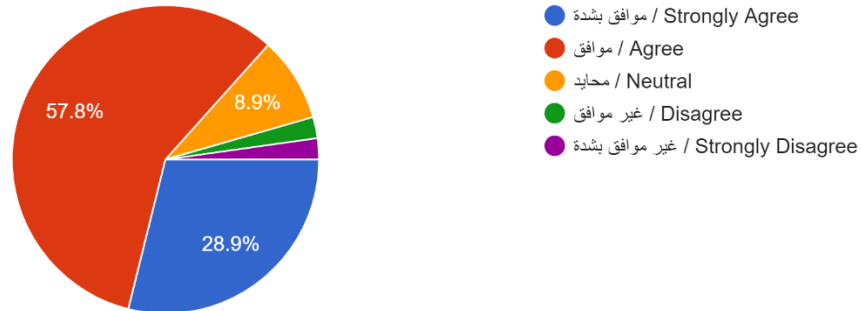
Contract-related causes: Cost-Consciousness in oil and gas construction projects can be affected due to: Poorly defined payment milestones

45 responses



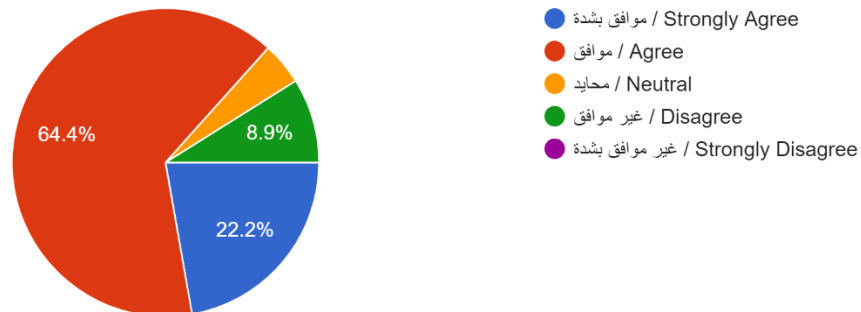
Contract-related causes: Cost-Consciousness in oil and gas construction projects can be affected due to: Lack of communication with suppliers in the engineering and procurement phases

45 responses



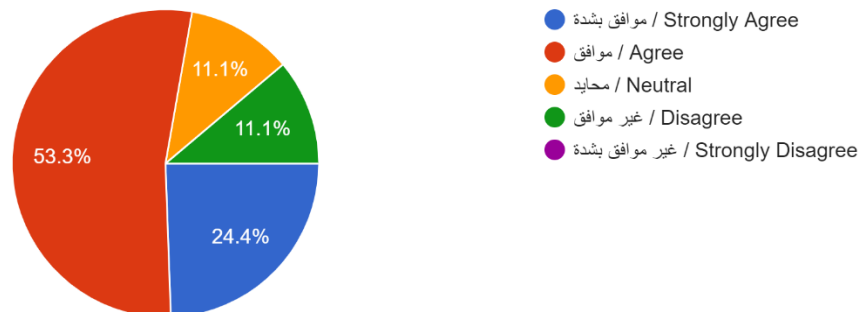
Contract-related causes: Cost-Consciousness in oil and gas construction projects can be affected due to: Poor project implementation strategies

45 responses



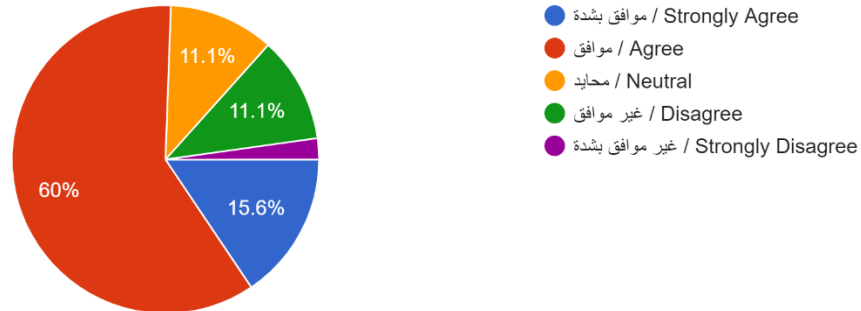
External-related causes: Cost-Consciousness in oil and gas construction projects can be affected due to: Impact of weather conditions on work

45 responses



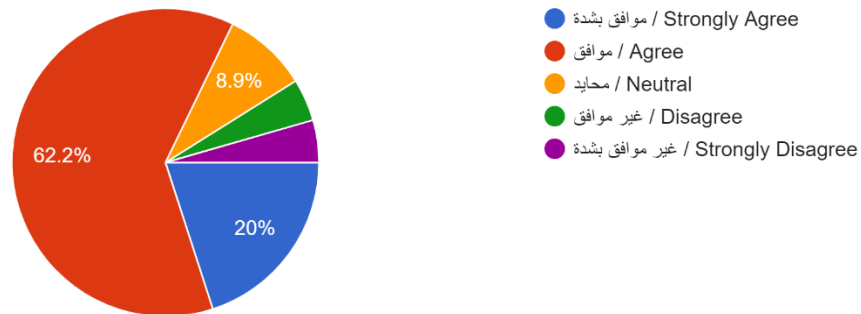
External-related causes: Cost-Consciousness in oil and gas construction projects can be affected due to: Impact of formation's stability on work

45 responses



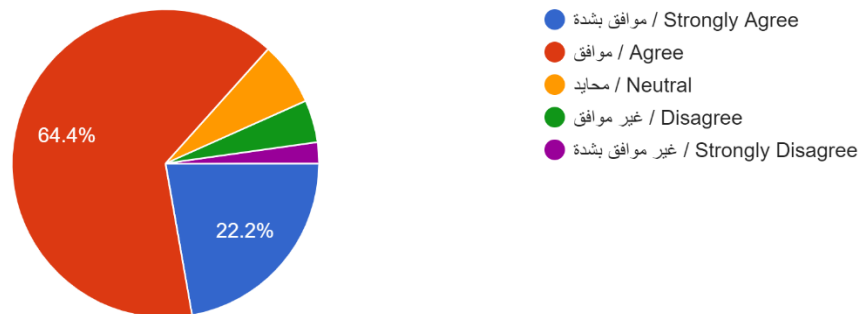
External-related causes: Cost-Consciousness in oil and gas construction projects can be affected due to: Impact of sea's condition on work

45 responses



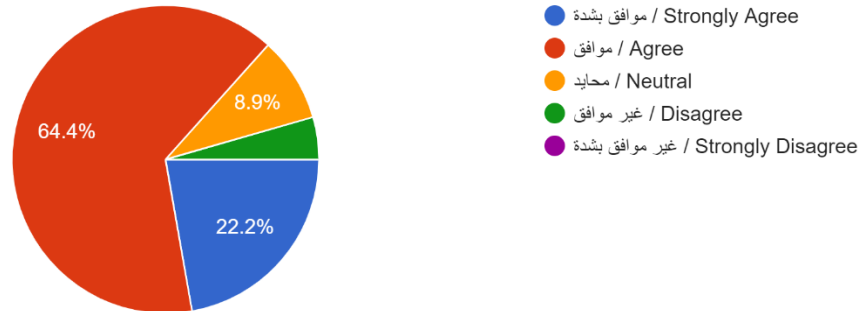
External-related causes: Cost-Consciousness in oil and gas construction projects can be affected due to: Impact of onshore/offshore's location on work

45 responses



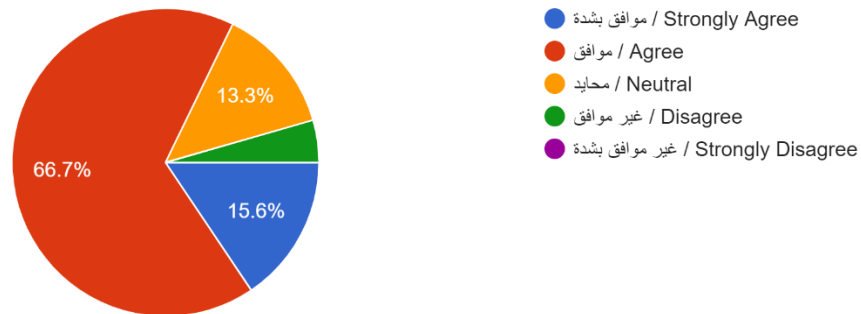
Owner-related causes: Cost-Consciousness in oil and gas construction projects can be affected due to: Deficient documentation and incomplete scope definition

45 responses



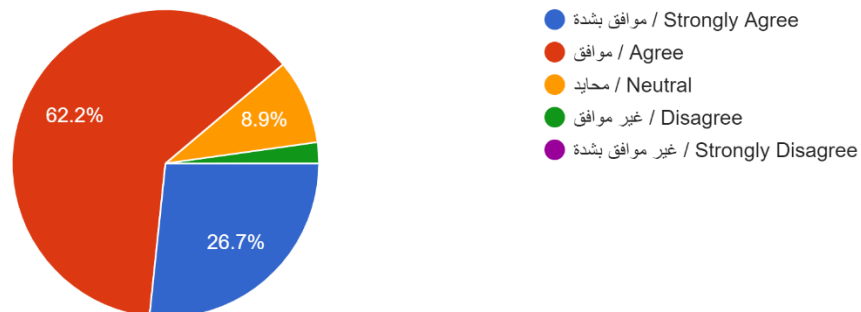
Owner-related causes: Cost-Consciousness in oil and gas construction projects can be affected due to: Changing of design and scope by client during construction

45 responses



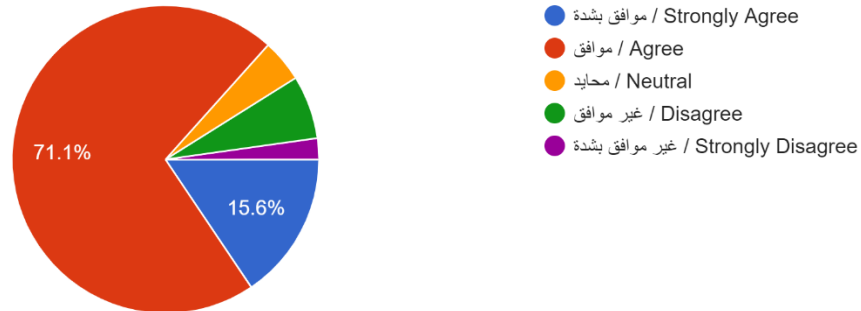
Owner-related causes: Cost-Consciousness in oil and gas construction projects can be affected due to: Long project approval procedures

45 responses



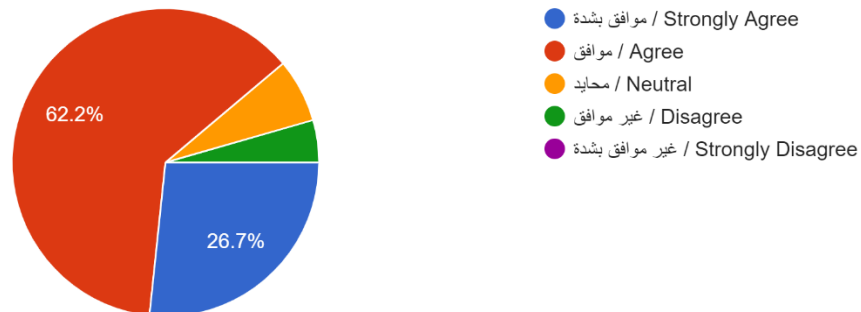
Owner-related causes: Cost-Consciousness in oil and gas construction projects can be affected due to: Many stakeholders

45 responses



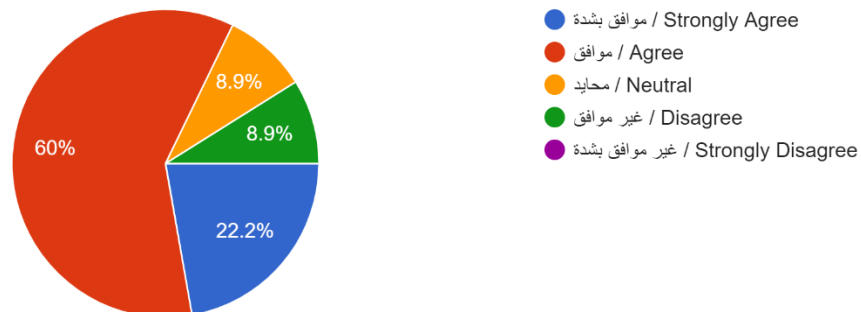
Owner-related causes: Cost-Consciousness in oil and gas construction projects can be affected due to: Poor definition of subsurface data

45 responses



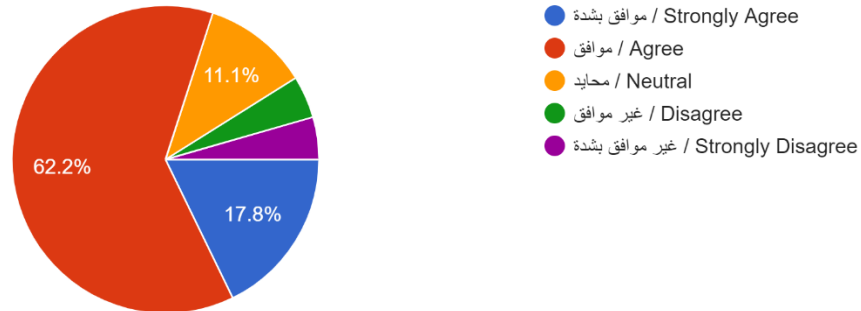
Resources-related causes: Cost-Consciousness in oil and gas construction projects can be affected due to: Labor's lack of skills and productivity

45 responses



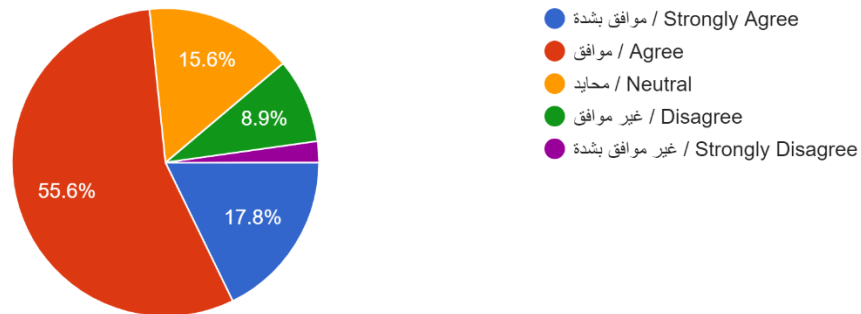
Resources-related causes: Cost-Consciousness in oil and gas construction projects can be affected due to: Lack of equipment

45 responses



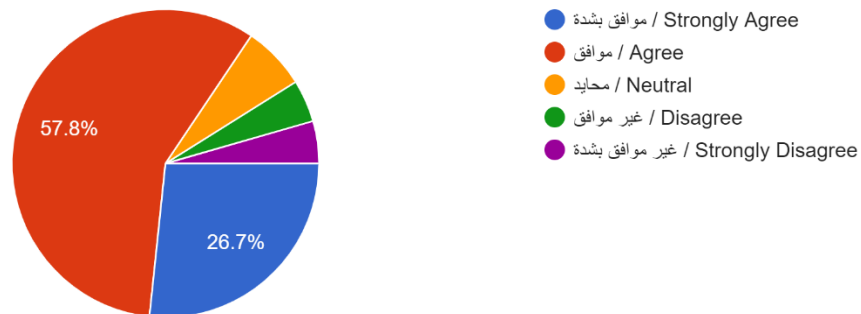
Resources-related causes: Cost-Consciousness in oil and gas construction projects can be affected due to: Manpower shortage

45 responses



Resources-related causes: Cost-Consciousness in oil and gas construction projects can be affected due to: Material procurement issues

45 responses



4.3. Validity & reliability tests for the questionnaires

In order to verify the validity and reliability of the measures used in the study, the internal consistency validity of the questionnaires used to measure the study variables was tested, in addition to measuring the convergent validity by measuring the Average Variance Extracted (AVE). While the reliability of the measures used in the study was measured by Measuring the value of Cronbach's alpha, through the structural equation modeling (SEM), using the statistical analysis program **SPSS** version **28** .The following paragraphs and tables explain this.

4.3.1 Validity of the measures used in the study

The internal consistency validity of the scales used to measure the study variables was tested, in addition to measuring the convergent validity by measuring the average variance extracted.

Internal consistency validity: It means the extent to which each statement of the questionnaire is consistent with the variable to which it belongs. Therefore, the researcher measured the internal consistency of the questionnaires by calculating the correlation coefficients between the score of each statement and the total score of the variable to which it belongs. According to Kaiser (1974) study, a correlation coefficient of less than 0.5 is removed from the questionnaire.

Convergent Validity: The average variance between statements that measure the same scale is measured by calculating the average variance extracted (AVE), whose value must be greater than 0.5 according to Hair et al (2006).

The following tables show the statistical results for (correlation coefficients, standard deviation, calculated T value, and P value between the score of each statement and the total score of the variable to measure the validity of the internal consistency of the questionnaires. Also, calculating the value of the average variance extracted (AVE) to measure the convergent validity of the questionnaires through the equation model. Structural **SPSS** version **28**, as follows:

Variable		Statements Description	KMO	Factor loadings	Standard deviation	P Values	Mean	Average variance extracted	
First variable	First dimension	All Parties-related causes Efficiency of Operations	0.642	0.799	0.815	0.00	4.13	4.01	4.02
				0.726	0.951	0.00	3.78		
				0.8	0.694	0.00	4.13		
	Second dimension	Consultant/designer- related causes: Efficiency of Operations		0.827	0.944	0.00	3.87		
				0.577	0.839	0.00	4.02		
				0.473	0.821	0.00	3.91		
				0.485	0.673	0.00	4.16		
				0.548	0.767	0.00	3.96		
				0.61	0.859	0.00	4.11		
				0.776	1.079	0.00	3.80	3.98	
	Third dimension	Contract-related causes: Efficiency of Operations		0.59	0.793	0.00	4.09		
				0.62	0.999	0.00	4.04		
				0.548	0.928	0.00	4.04		
				0.799	0.9	0.00	3.91		
	Fourth dimension	External-related causes: Efficiency of Operations		0.828	0.878	0.00	4.04	4.05	
				0.71	0.783	0.00	3.98		
				0.61	0.726	0.00	4.20		
				0.697	0.878	0.00	3.96		
	Fifth dimension	Owner-related causes: Efficiency of Operations		0.586	0.812	0.00	3.98	4.03	
				0.779	0.959	0.00	3.89		
				0.722	0.815	0.00	4.20		
				0.719	0.737	0.00	4.04		
				0.656	0.812	0.00	4.02		
	Sixth dimension	Resources-related causes: Efficiency of Operations		0.689	0.726	0.00	4.13	4.06	
0.532			0.905	0.00	4.00				
0.621			0.783	0.00	4.02				
0.759			0.837	0.00	4.07				
0.768			0.78	0.00	4.07				
0.808			0.927	0.00	3.78				
0.842			0.965	0.00	3.98				

Variable		Statements Description	KMO	Factor loadings	Standard deviation	P Values	Mean	Average variance extracted	
Second variable	First dimension	All Parties-related causes Project Budget and Economy	0.608	0.874	0.929	0.00	4.00	3.83	3.93
				0.663	1.1	0.00	3.71		
				0.584	0.997	0.00	3.78		
	Second dimension	Consultant/designer-related causes: Project Budget and Economy		0.601	1.214	0.00	3.73		
				0.52	0.925	0.00	3.91		
				0.772	0.991	0.00	3.87		
				0.644	1.043	0.00	3.84		
				0.752	1.062	0.00	3.91		
				0.531	1.021	0.00	4.04		
				0.612	0.67	0.00	4.22	3.94	
	Third dimension	Contract-related causes: Project Budget and Economy		0.626	0.812	0.00	4.02		
				0.803	1.014	0.00	3.80		
				0.731	0.944	0.00	3.80		
				0.64	0.976	0.00	3.84		
				0.828	0.763	0.00	3.91	3.93	
	Fourth dimension	External-related causes: Project Budget and Economy		0.8	0.866	0.00	4.02		
				0.59	0.863	0.00	3.93		
				0.592	0.999	0.00	3.84		
				0.828	0.903	0.00	3.96	4.01	
	Fifth dimension	Owner-related causes: Project Budget and Economy		0.567	0.821	0.00	4.09		
				0.811	0.952	0.00	3.84		
				0.729	0.654	0.00	4.07		
				0.562	0.763	0.00	4.09		
				0.84	0.952	0.00	4.04	4.02	
	Sixth dimension	Resources-related causes: Project Budget and Economy		0.862	0.952	0.00	3.84		
				0.822	0.647	0.00	4.11		
				0.768	0.78	0.00	4.07		

Variable		Statements Description	KMO	Factor loadings	Standard deviation
Third variable	First dimension	All Parties-related causes Cost-Consciousness	0.554	0.809	0.694
				0.576	0.974
				0.887	0.783
	Second dimension	Consultant/designer-related causes: Cost-Consciousness		0.615	0.903
				0.573	0.611
				0.828	0.737
				0.589	0.886
				0.904	0.944
				0.509	0.753
				0.811	0.751
	Third dimension	Contract-related causes: Cost-Consciousness		0.605	0.737
				0.582	0.925
				0.787	0.821
				0.46	0.798
	Fourth dimension	External-related causes: Cost-Consciousness		0.77	0.9
				0.736	0.933
				0.543	0.935
				0.578	0.826
	Fifth dimension	Owner-related causes: Cost-Consciousness		0.708	0.706
				0.551	0.688
				0.851	0.661
				0.812	0.821
				0.59	0.714
				0.686	0.824
	Sixth dimension	Resources-related causes: Cost-Consciousness		0.477	0.928
				0.808	0.927
				0.842	0.965

It is clear from the table above:

The scale of applying the first variable: All correlation coefficients for all statements are strongly correlated with their dependent variable **(the variable and its dimensions)**, at values greater than 0.7. In addition, the values of all correlation coefficients for the statements are statistically significant at a significance level less than 0.001. Accordingly, the internal consistency validity of the scale has been achieved. Also, from the results above related to the value of the average variance extracted AVE, it is clear that its value for the variable of applying **(the variable and its dimensions)** is $0.565 > 0.5$. Accordingly, the convergent validity of the questionnaire has been achieved.

The scale of applying the second variable: All correlation coefficients for the statements that measure **(the variable and its dimensions)** have a value greater than 0.7. In addition, the values of all correlation coefficients for the statements are statistically significant at a significance level

less than 0.0001. Accordingly, the internal consistency validity of the scale has been achieved in its three dimensions. Also, from the results above related to the value of the average variance extracted AVE for the variable of **(the variable and its dimensions)** as a whole, which is equal to 0.736, the values of the average variance extracted **(for the dimensions of the variable)** are: 0.770, 0.0758, respectively. Accordingly, the convergent validity of the questionnaire has been achieved.

4.3.2 Reliability of the study tool

The stability of the questionnaire refers to the stability of the questionnaire results and their non-change significantly if they were redistributed to the sample individuals several times during specific time periods. To measure the stability of the questionnaires used to measure the study variables,

Cronbach's alpha values were calculated using SPSS version 28. According to (2010) Hair et al, the value must be greater than 0.7 for the scale to be stable.

Variable		Statements Description	Number of Statements	Cronbach's alpha		
First variable	First dimension	All Parties-related causes Efficiency of Operations	3	0.935 0.934 0.935	0.935	0.934
	Second dimension	Consultant/designer-related causes: Efficiency of Operations	6	0.932 0.934 0.934 0.934 0.934 0.934	0.934	
	Third dimension	Contract-related causes: Efficiency of Operations	5	0.935 0.935 0.934 0.934 0.934	0.934	
	Fourth dimension	External-related causes: Efficiency of Operations	4	0.934 0.934 0.937 0.934	0.935	
	Fifth dimension	Owner-related causes: Efficiency of Operations	5	0.933 0.934 0.937 0.935 0.935	0.935	
	Sixth dimension	Resources-related causes: Efficiency of Operations	4	0.935 0.934 0.934 0.936	0.935	

(First Variable and the dimensions): The statistical results showed that the values of Cronbach's alpha are mentioned on the above table, which indicates that all values are greater than 0.7. According to Hair et al (2010), the stability of the scale has been achieved.

Variable		Statements Description	Number of Statements	Cronbach's alpha		
Second variable	First dimension	All Parties-related causes Project Budget and Economy	3	0.925	0.923	0.923
				0.921		
				0.922		
	Second dimension	Consultant/designer-related causes: Project Budget and Economy	6	0.919	0.922	
				0.924		
				0.923		
				0.921		
				0.921		
				0.924		
	Third dimension	Contract-related causes: Project Budget and Economy	5	0.924	0.923	
				0.924		
				0.923		
				0.921		
				0.923		
	Fourth dimension	External-related causes: Project Budget and Economy	4	0.924	0.923	
				0.923		
				0.922		
				0.921		
	Fifth dimension	Owner-related causes: Project Budget and Economy	5	0.922	0.923	
				0.924		
				0.923		
				0.923		
				0.922		
	Sixth dimension	Resources-related causes: Project Budget and Economy	4	0.923	0.925	
				0.924		
				0.925		
				0.926		

(Second Variable and the dimensions): The statistical results showed that the values of Cronbach's alpha are as per the above table, which indicates that all values are greater than 0.7. According to Hair et al (2010), the stability of the scale has been achieved.

Variable		Statements Description	Number of Statements	Cronbach's alpha		
Third variable	First dimension	All Parties-related causes Cost-Consciousness	3	0.895	0.895	0.896
				0.892		
				0.899		
	Second dimension	Consultant/designer-related causes: Cost-Consciousness	6	0.895	0.896	
				0.896		
				0.895		
				0.894		
				0.899		
				0.897		
				0.897		
	Third dimension	Contract-related causes: Cost-Consciousness	5	0.898	0.897	
				0.896		
				0.895		
				0.898		
				0.897		
	Fourth dimension	External-related causes: Cost-Consciousness	4	0.895	0.896	
				0.897		
				0.895		
				0.897		
	Fifth dimension	Owner-related causes: Cost-Consciousness	5	0.897	0.897	
				0.899		
				0.895		
				0.895		
				0.899		
	Sixth dimension	Resources-related causes: Cost-Consciousness	4	0.899	0.896	
				0.895		
				0.894		
0.895						

(Third Variable and the dimensions): The statistical results showed that the values of Cronbach's alpha are per the above, which indicates that all values are greater than 0.7 . According to Hair et al (2010), the stability of the scale has been achieved.

4.4. Descriptive statistics for research variables (answer research questions)

The following table shows the descriptive analysis of the study variables represented by the arithmetic means based on the five-point Likert scale and the standard deviations of the variables according to the table related to the importance of the arithmetic mean.

Variable		Number of Statements	Arithmetic Mean		Std. Deviation		Relative Index			Importance Level		
First variable	First dimension	3	4.13	4.013	0.815	0.820	0.83	0.83	0.80	High	High	High
			3.78		0.951		0.76			High-Medium		
			4.13		0.694		0.83			High		
	Second dimension	6	3.87	4.005	0.944	0.817	0.77	0.77		High-Medium	High	
			4.02		0.839		0.80			High		
			3.91		0.821		0.78			High-Medium		
			4.16		0.673		0.83			High		
			3.96		0.767		0.79			High-Medium		
			4.11		0.859		0.82			High		
	Third dimension	5	3.8	3.976	1.079	0.940	0.76	0.76		High-Medium	High	
			4.09		0.793		0.82			High		
			4.04		0.999		0.81			High		
			4.04		0.928		0.81			High		
			3.91		0.9		0.78			High-Medium		
	Fourth dimension	4	4.04	4.045	0.878	0.816	0.81	0.81		High	High	
			3.98		0.783		0.80			High		
			4.2		0.726		0.84			High		
			3.96		0.878		0.79			High-Medium		
	Fifth dimension	5	3.98	4.026	0.812	0.827	0.80	0.80		High	High	
			3.89		0.959		0.78			High-Medium		
			4.2		0.815		0.84			High		
			4.04		0.737		0.81			High		
			4.02		0.812		0.80			High		
	Sixth dimension	4	4.13	4.055	0.726	0.813	0.83	0.83		High	High	
			4		0.905		0.80			High		
			4.02		0.783		0.80			High		
			4.07		0.837		0.81			High		

Variable		Number of Statement s	Arithmetic Mean		Std. Deviation		Relative Index			Importance Level		
Second variable	First dimension	3	4	3.830	0.929	1.009	0.80	0.80	0.80	High	High-Medium	High
			3.71		1.1		0.74			High-Medium		
			3.78		0.997		0.76			High-Medium		
	Second dimension	6	3.73	3.883	1.214	1.043	0.75	0.75		High-Medium	High-Medium	
			3.91		0.925		0.78			High-Medium		
			3.87		0.991		0.77			High-Medium		
			3.84		1.043		0.77			High-Medium		
			3.91		1.062		0.78			High-Medium		
			4.04		1.021		0.81			High		
	Third dimension	5	4.22	3.936	0.67	0.883	0.84	0.84		High	High-Medium	
			4.02		0.812		0.80			High		
			3.8		1.014		0.76			High-Medium		
			3.8		0.944		0.76			High-Medium		
			3.84		0.976		0.77			High-Medium		
	Fourth dimension	4	3.91	3.925	0.763	0.873	0.78	0.78		High-Medium	High-Medium	
			4.02		0.866		0.80			High		
			3.93		0.863		0.79			High-Medium		
			3.84		0.999		0.77			High-Medium		
	Fifth dimension	5	3.96	4.010	0.903	0.819	0.79	0.79		High-Medium	High	
			4.09		0.821		0.82			High		
			3.84		0.952		0.77			High-Medium		
			4.07		0.654		0.81			High		
			4.09		0.763		0.82			High		
	Sixth dimension	4	4.04	4.015	0.952	0.833	0.81	0.81		High	High	
			3.84		0.952		0.77			High-Medium		
			4.11		0.647		0.82			High		
			4.07		0.78		0.81			High		

Variable		Number of Statements	Arithmetic Mean		Std. Deviation		Relative Index			Importance Level		
Third variable	First dimension	3	4.2	4.000	0.694	0.817	0.84	0.84	0.80	高 - 中	High	
			3.78		0.974		0.76			中 - 低		
			4.02		0.783		0.80			High		
	Second dimension	6	3.84	3.930	0.903	0.806	0.77	0.77		High-Medium	High-Medium	
			4.11		0.611		0.82			High		
			3.96		0.737		0.79			High-Medium		
			3.82		0.886		0.76			High-Medium		
			3.87		0.944		0.77			High-Medium		
			3.98		0.753		0.80			High		
			Third dimension		5		4.07			3.982		0.751
	3.84	0.737		0.77		High-Medium						
	3.91	0.925		0.78		High-Medium						
	4.09	0.821		0.82		High						
	4	0.798		0.80		High						
	Fourth dimension	4		3.91		3.890	0.9	0.899			0.78	0.78
			3.76	0.933	0.75		High-Medium					
			3.89	0.935	0.78		High-Medium					
			4	0.826	0.80		High					
	Fifth dimension	5	4.04	4.024	0.706	0.718	0.81	0.81		High	High	
			3.93		0.688		0.79					
			4.13		0.661		0.83			High		
			3.91		0.821		0.78					
			4.11		0.714		0.82			High		
	Sixth dimension	4	3.96	3.890	0.824	0.911	0.79	0.79		High-Medium	High-Medium	
			3.84		0.928		0.77			High-Medium		
			3.78		0.927		0.76			High-Medium		
			3.98		0.965		0.80			High		

4.5. Testing Hypotheses & Findings Discussion

Description table for the study sample

Variable	Variable Classes	The Number	Percentage of the total sample
Gender	Male	31	68.90%
	Female	14	31.10%
	Total	45	100%
The age group	Less than 20 years	4	8.90%
	From 20 to 30 years	10	22.20%
	From 31 to 40 years	11	24.40%
	From 41 to 50 years	13	28.90%
	From 51 to 60 years	7	15.60%
	Total	45	100%
Marital status	Single	10	22.20%
	Married	17	37.80%
	Divorced	13	28.90%
	Widower	5	11.10%
	Total	45	100%
Qualification	High School	10	22.20%
	Diploma	6	13.30%
	Bachelor's	13	28.90%
	Master's	10	22.20%
	Ph.D	6	13.30%
	Total	45	100%
Function	Administrative	7	15.60%
	Employee	8	17.80%
	Engineer	12	26.70%
	Manager	11	24.40%
	Director	7	15.60%
	Total	45	100%
Years of Experience	Less than one year	8	17.80%
	From 1 year to 4 years	12	26.70%
	From 5 years to 10 years	13	28.90%
	More than 10 years	12	26.70%
	Total	45	100%

4.6. Conclusion

- From the results of the previous statistics, it is clear that:
 - o There is a positive relationship with statistical significance between the independent variable and the dependent variables. This is supporting the initial hypothesis we have made at the beginning of this research.

5. Chapter 5: Research limitations, Recommendations & Conclusion

5.1. Research Limitations & Future Research

5.2. Research Recommendations

5.3. Conclusion

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Appendix

Questionnaire Introduction

I am conducting a complementary study as part of my project management degree program. The study is entitled "The Impact of Optimization on Reducing Construction Costs in the Oil and Gas Sector in Dhahran, Saudi Arabia: A Case Study of Saudi Aramco's Projects." As part of this study, I aim to explore the contribution of social responsibilities to improving the efficiency of operations within the Oil and Gas sector in Saudi Aramco.

I kindly request your cooperation in answering the following questions clearly and objectively. Your input will help in obtaining valid results for my research topic. Your response will be used for scientific research purposes and will be handled with complete confidentiality. Please mark (x) in the appropriate box to indicate your consent.

Thank you for your support and cooperation.

Haitham Al-Haj

Personal Information:

Note: to answer by placing mark (x), in the right box.

1- Sex:

Male ()

Female ()

2- Age:

-From 18 to less than 25 years old () -From 25 to less than 35 years old ()

-From 35 to less than 50 years old () -Older than 50 years old. ()

Questionnaire number one:

Link: https://docs.google.com/forms/d/1VI3C_yRh8B2Bc9HqE0V1OHNohmWtK_IG2N2_YfF8s2w/edit

Information about the efficiency of operations within the Oil and Gas sector in Saudi Aramco.

#	Question	Strongly agree	Agree	Neutral	Dis agree	Strongly disagree
1	Efficiency in Oil and Gas construction project can be affected due to: an incompetent project team					
2	Efficiency in Oil and Gas construction project can be affected due to: drilling and completions projects design errors					
3	Efficiency in Oil and Gas construction project can be affected due to: Inadequate cost estimating approach /inaccurate material estimation					
4	Efficiency in Oil and Gas construction project can be affected due to: clash between two or more service companies from different parties					
5	Efficiency in Oil and Gas construction project can be affected due to: Poor planning and scheduling of project					
6	Efficiency in Oil and Gas construction project can be affected due to: Inadequate quality control/assurance					
7	Efficiency in Oil and Gas construction project can be affected due to: Negligence of site visits before/during the operations process					
8	Efficiency in Oil and Gas construction project can be affected due to: Inadequate management of contractor 's schedule by the client team					
9	Efficiency in Oil and Gas construction project can be affected due to: Unforeseen conditions and project modifications					
10	Efficiency in Oil and Gas construction project can be affected due to: Weak and insufficient technical studies					

Table 8: Questionnaire number one

Questionnaire number two:

Link: https://docs.google.com/forms/d/1yLGKDD9WlkJ_drzSRICqdwVZOqUuTVGgggMnxqSoIQQ/edit

Information about the budget and economy within the Oil and Gas sector in Saudi Aramco.

#	Question	Strongly agree	Agree	Neutral	Dis agree	Strongly disagree
1	The project budget and economy in Oil and Gas construction project can be affected due to: an incompetent project team					
2	The project budget and economy in Oil and Gas construction project can be affected due to: drilling and completions projects design errors					
3	The project budget and economy in Oil and Gas construction project can be affected due to: Inadequate cost estimating approach /inaccurate material estimation					
4	The project budget and economy in Oil and Gas construction project can be affected due to: clash between two or more service companies from different parties					
5	The project budget and economy in Oil and Gas construction project can be affected due to: Poor planning and scheduling of project					
6	The project budget and economy in Oil and Gas construction project can be affected due to: Inadequate quality control/assurance					
7	The project budget and economy in Oil and Gas construction project can be affected due to: Negligence of site visits before/during the operations process					
8	The project budget and economy in Oil and Gas construction project can be affected due to: Inadequate management of contractor 's schedule by the client team					
9	The project budget and economy in Oil and Gas construction project can be affected due to: Unforeseen conditions and project modifications					
10	The project budget and economy in Oil and Gas construction project can be affected due to: Weak and insufficient technical studies					

Table 9: Questionnaire number two

Questionnaire number three:

Link: https://docs.google.com/forms/d/16wKivIcXAXGtQs-5xYdV4---XJl_1d2El4_TqzW7kctc/prefill

Information about the cost-consciousness within the Oil and Gas sector in Saudi Aramco.

#	Question	Strongly agree	Agree	Neutral	Dis agree	Strongly disagree
1	The cost-consciousness in Oil and Gas construction project can be affected due to: an incompetent project team					
2	The cost-consciousness in Oil and Gas construction project can be affected due to: drilling and completions projects design errors					
3	The cost-consciousness in Oil and Gas construction project can be affected due to: Inadequate cost estimating approach /inaccurate material estimation					
4	The cost-consciousness in Oil and Gas construction project can be affected due to: clash between two or more service companies from different parties					
5	The cost-consciousness in Oil and Gas construction project can be affected due to: Poor planning and scheduling of project					
6	The cost-consciousness in Oil and Gas construction project can be affected due to: Inadequate quality control/assurance					
7	The cost-consciousness in Oil and Gas construction project can be affected due to: Negligence of site visits before/during the operations process					
8	The cost-consciousness in Oil and Gas construction project can be affected due to: Inadequate management of contractor 's schedule by the client team					
9	The cost-consciousness in Oil and Gas construction project can be affected due to: Unforeseen conditions and project modifications					
10	The cost-consciousness in Oil and Gas construction project can be affected due to: Weak and insufficient technical studies					

Table 10: Questionnaire number three